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Editors
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About the Editors

DR. ANMING ZHANG, the Acting Head of the Department of Economics and Finance at City University of Hong Kong, joined the City as an associate professor in 1996 after teaching at University of Victoria, Canada, for six years. He received a BSc from Shanghai Jiao Tong University, MSc and PhD (1990, Economics and Business Admin.) from University of British Columbia. Dr. Zhang has published more than 20 research papers in the areas of industrial organization, international trade, and transportation. He received the Yokohama Special Prize for an Outstanding Young Researcher, awarded at the 7th World Conference on Transportation Research (WCTR), Sydney, Australia, July 1995. He won again the Overall Best Paper award (with Tae Oum and Yimin Zhang) at the 8th WCTR, Antwerp, Belgium, July 1998. Dr. Zhang has also done extensive consultancy work for government and industry.

DR. BRENT D. BOWEN is Director and Professor, Aviation Institute, University of Nebraska at Omaha. He has been appointed as a Graduate Faculty of the University of Nebraska System-wide Graduate College. Bowen attained his Doctorate in Higher Education and Aviation from Oklahoma State University and a Master of Business Administration degree from Oklahoma City University. His Federal Aviation Administration certifications include Airline Transport Pilot, Certified Flight Instructor, Advanced-Instrument Ground Instructor, Aviation Safety Counselor, and Aerospace Education Counselor. Dr. Bowen's research interests focus on aviation applications of public productivity enhancement and marketing in the areas of service quality evaluation, forecasting, and student recruitment in collegiate aviation programs. He is also well published in areas related to effective teaching. His professional affiliations include the University Aviation Association, Council on Aviation Accreditation, World Aerospace Education Organization, International Air Transportation Research Group, Aerospace Education Association, Alpha Eta Rho International Aviation Fraternity, and the Nebraska Academy of Sciences. He also serves as program director and principal investigator of the National Aeronautics and Space Administration funded Nebraska Space Grant and EPSCoR Programs.

ATRG President's Foreword

The **Air Transport Research Group** of the WCTR Society was formally launched as a special interest group at the 7th Triennial WCTR in Sydney, Australia in 1995. Since then, our membership base has expanded rapidly, and includes nearly 600 active transportation researchers, policy-makers, industry executives, major corporations and research institutes from 28 countries. Our broad base of membership and their strong enthusiasm have pushed the group forward, to continuously initiate new events and projects which will benefit aviation industry and research communities worldwide.

It became a tradition that the ATRG holds an international conference at least once per year . As you know, the 1997 conference was held in Vancouver, Canada. Over 90 papers, panel discussions and invited speeches were presented. In 1998, the ATRG organized a consecutive stream of 14 aviation sessions at the 8th Triennial WCTR Conference (July 12-17: Antwerp). Again, on 19-21 July, 1998, the ATRG Symposium was organized and executed every successfully by Dr. Aisling Reynolds-Feighan of the University College of Dublin.

In 1999, the City University of Hong Kong has hosted the 3rd Annual ATRG Conference. Despite the delay in starting our conference sessions because of Typhoon Maggie, we were able to complete the two-day conference sessions and presentation of all of the papers. On behalf of the ATRG membership, I would like to thank Dr. Anming Zhang who organized the conference and his associates and assistants for their effort which were essential for the success of the conference. Our special thanks go to Professor Richard Ho, Dean of the School of Business and Economics of the University for the generous support for the conference. Many of us also enjoyed the technical visit to the new Hong Kong International Airport (Chep Lok Kok).

As you know, Professor Jaap de Wit and I look forward to welcoming you to University of Amsterdam on July 2-4, 2000 for the 4th Annual ATRG Conference.

As in the past, the Aviation Institute of the University of Nebraska at Omaha (Dr. Brent Bowen , Director of the Institute) has kindly agreed to publish the Proceedings of the 1999 ATRG Hong Kong Conference (being co-edited by Dr. Anming Zhang and Professor Brent Bowen). On behalf of the ATRG members, I would like to express my sincere appreciation to Professor Brent Bowen, Mary M. Schaffart and the staff of the Aviation Institute of University of Nebraska at Omaha for the effort to publish these ATRG proceedings. Also, I would like to thank and congratulate all authors of the papers for their fine contribution to the conferences and the Proceedings. Our special thanks are extended to Boeing Commercial Aviation – Marketing Group for the partial support for publication of this proceedings.

Finally, I would like to draw your attention to the ATRG newsletter and the ATRG website (www.commerce.ubc.ca/atrg/) which will keep you informed of the ATRG operations and forthcoming events. On behalf of the ATRG Networking Committee, I would appreciate it very much if you could suggest others to sign up the ATRG membership. Thank you for your attention.

Tae H. Oum
President, ATRG

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Air Transport Research Group (ATRG)
International Conference on Air Transportation Operations and Policy
City University of Hong Kong
June 6-8, 1999

The Conference

The ATRG held its 3rd Annual Conference at the City University of Hong Kong Campus in June 1999.

The 1999 Conference contained 13 aviation and airport sessions. Over 40 research presentations were featured on topics pertaining to airports and aviation; these titles are listed on the ATRG website (http://www.commerce.ubc.ca/atrg/).

The Proceedings

Once again, on behalf of the Air Transport Research Group, the University of Nebraska at Omaha Aviation Institute has agreed to publish the Proceedings of the ATRG Conference in a four-volume monograph set.

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The Effects of Operating and Financial Leverage on the Stability of Airline Returns Over Time: The Contrast Between Southwest, Delta and USAir.

by

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Introduction

Through the early months of 1999, the country's major airlines have continued to enjoy an unprecedented prosperity. Low fuel costs and rock-bottom interest rates have combined with the fruits of past labor concessions and the on-going American economic boom to create an extremely favorable operating environment. Add to this the increase in industry concentration due to airline mergers and alliances, and the sizable built-up operating and financial leverage that characterizes the industry, and it is no wonder that record profits have been the recent rule. In our view, this last factor—the prevalence of substantial built-up operating and financial leverage in the airline industry—is of particular interest. Having been widely blamed for creating past industry problems, these high-leverage positions now serve to magnify the beneficial influence of the other cited factors to swell current airline profitability. However, even in such prosperous times the potential danger of these positions should not be ignored.

This study highlights by example the effects of varying leverage positions on airline profitability. To accomplish this, we've applied previously-developed measures of risk to three major U.S. air carriers— Southwest (SWA), Delta (DAL), and U.S. Air (USAir).[1] These particular carriers offer significant contrasts: SWA has always been a strong performer, conservatively financed; USAir has had several bouts with severe financial problems due to excessive debt finance; Delta is a carrier between the two extremes in both performance and philosophy, but a carrier considered by most analysts to be one of the strongest in the industry.

Background

It is no secret that the air transport is among the more volatile of American industries.[2] On the operating side, demand for air transport is highly cyclical. In many markets, carriers face intense competition. Add to this significant fixed operating costs and it is not difficult to appreciate the inherent instability of the industry's operating profits. Such conditions are typical of an industry which exhibits a high degree of what financial analysts would label "business risk." On the financial side, the high debt loads of most carriers create a significant fixed-charge burden (in the form of interest) which leaves them extremely vulnerable to both interest rate increases and economic cycles. As a consequence, most industry members show a high degree of "financial risk." As will be demonstrated, high levels of both risks can result in dramatic changes in profitability.

The Nature of Risk

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[1] The paper is an update and revision of research published by the authors last year. See: "Measuring the Degrees of Operating, Financial and Combined Leverage for the Major U.S. Air Carriers: 1979-1995," Transportation Law Journal, XXVI No.1 (Fall 1998), 51-71.

[2] This has been documented in several prior studies contrasting the airlines to other industrial groups, both before and after deregulation: Richard D. Gritta, "An Unresolved Issue in Setting the Cost of Capital to the U.S. Domestic Airlines," Journal of Air Law & Commerce, XL(Winter 1975), 65-74, especially Chart I; Richard D. Gritta, Garland Chow, and Todd Shank, "The Causes and Effects of Business and Financial Risk in Air Transportation," Journal of Transportation Management, VI No.1(Spring 1994), 127-149.

To understand the special risk-related dangers associated with the airline industry, it is important to recognize that all firms and industries face three different levels of risk: business risk, financial risk, and total (or combined) risk. Business risk reflects the variability in a firm's operating profits, or earnings before interest and taxes (EBIT), over time. Such risk is primarily a function of demand volatility, the inherent cost structure of the industry of which the firm is a member, and the level of intra-industry competition faced by the firm. In most industries, fixed costs are seen as the principal culprit in producing high levels of business risk since their presence magnifies the effects of revenue changes on operating profits. The airline industry is considered to be especially high in business risk because it is highly cyclical, intensely competitive, and exhibits a significant level of fixed costs.

Financial risk is usually defined as the added variability in earnings to stockholders due to the use of long-term debt finance to acquire assets. Similar to the exacerbating influence of fixed costs on business risk, interest acts as a lever to magnify returns (positive and negative) and thus increase a firm's level of financial risk. Because most air carriers utilize significant amounts of debt, the industry is generally high in such risk.

Combined risk, as its name suggests, is the result of the interaction of business and financial risk. It is important to note that the two risks combine in a multiplicative—rather than a simple additive—way. As will be demonstrated shortly, it's this fact that has contributed to the precarious position of many of the country's major carriers in the past.

Measuring Business and Financial Risk

Elasticity measures borrowed from microeconomic theory can be used to quantify business and financial risk. With such measures, it's possible to trace directly the effects of leverage on operating and net profits, as well as on returns to assets and returns to equity.[3]

The appropriate measures are defined below:

[3] For a complete discussion of the nature and measurement of risk and return, see any standard financial management textbook. For example: R. Charles Moyer, James R. McGuigan, and William Kretlow, Contemporary Financial Management. 7th edition, (St. Paul, MN:West Publishing Co., 1997). Ch.13-14.

(1) Degree of Operating Leverage (DOL)[4]

$$\text{DOL} = \frac{\text{R} - \text{V}}{\text{R} - \text{V} - \text{F}}$$

where R = operating revenue
V = variable costs
F = fixed costs

(2) Degree of Financial Leverage (DFL)

$$\text{DFL} = \frac{\text{R} - \text{V} - \text{F}}{\text{R} - \text{V} - \text{F} - \text{I}}$$

where I = Interest
EBIT = R-V-F

(3) Degree of Combined Leverage (DCL)

$$\text{DCL} = \text{DOL x DFL}$$

$$= \frac{\text{R} - \text{V}}{\text{R} - \text{V} - \text{F}} x \frac{\text{R} - \text{V} - \text{F}}{\text{R} - \text{V} - \text{F} - \text{I}}$$

[4] As an elasticity measure, DOL=% change in operating profits (EBIT) divided by %change in operating revenues (OR). Operating revenues can be defined as pq (price per unit of output *times* output) and variable costs (V) equal vq (variable cost per unit *times* output). Thus, if the values of p and v remain constant, and fixed costs (F), by definition, are constant

$$\text{DOL} = \frac{\%\Delta EBIT}{\%\Delta OR} = \frac{\dfrac{\Delta q(p-v)}{q(p-v)-F}}{\dfrac{\Delta qp}{qp}} = \frac{\Delta q(p-v)}{q(p-v)-F} x \frac{q}{\Delta q} = \frac{q(p-v)}{q(p-v)-F}$$

$$= \frac{R-V}{R-V-F}$$

The other leverage measures are derived in a similar fashion.

$$= \frac{R - V}{R - V - F - I}$$

DOL is a direct measure of business risk, while DFL and DCL gauge financial risk and total risk, respectively. As elasticities, these measures indicate the relative rates of change in one variable, given changes in another. DOL measures the % change in operating profit or EBIT (R-V-F) given a 1% change in operating revenue (R). [For example, if DOL = +4.0, then EBIT will increase (decrease) 4% for each 1% increase (decrease) in operating revenues]. Similarly, DFL measures the % change in net profit (R-V-F-I) given a 1% change in EBIT. DCL measures the % change in net profit given a 1% change in revenue. (Since tax rates are constant, we use net profits before taxes.) In each case, the higher the value produced, the greater the relative risk. Crucially, since DCL is the multiplicative result of DOL and DFL, it is a sound principle of finance that firms high in business risk should avoid significant long-term debt finance.[5] [6]

The Leverage-Performance Connection

For this study, ROA (return on assets) and ROE (return on equity) have been used as primary indicators of carrier profitability. More specifically, baseline carrier performance is indicated by average ROA and ROE values over the period of the study; the standard deviation and coefficient of variation of the ROA and ROE values are used to measure performance stability/volatility.

As will be seen from study results, business risk directly impacts the stability of ROAs over time. The higher the level of business risk, the more unstable the return on assets (and the greater its standard deviation/coefficient of variation). Financial risk acts to further destabilize the ROEs over time, given the mean ROAs and their variability. The higher the level of financial risk, the greater the incremental change in ROEs given changes in ROAs. Finally, combined risk impacts the overall stability of ROEs over time. Importantly, high levels of combined risk result in very unstable returns (large standard deviations, or coefficients of variation, over time).

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[5] Ibid.

[6] Two earlier studies have examined this principle and its effects on stockholder returns: Richard D. Gritta, "The Effects of Financial Leverage on Air Carrier Earnings: A Break-Even Analysis," Financial Management. VIII(Summer 1979), 53-60, and; Richard D. Gritta, Garland Chow, and Ron Hockstein, "Airline Financial Policies in a Deregulated Environment," Transportation Journal. XXVII(Spring 19SS), 37-4S.

Data and Analysis

The analysis in this study is based on data for the three carriers identified above (SWA, Delta and USAir) for the years 1979 to 1997. This period represents the entire history of the carriers since the deregulation of the industry in 1978.

The raw data, compiled from DOT's **Air Carrier Financial Statistics Quarterly**, appear in Tables I , II, and III. For purposes of the study, variable costs are defined as the cost of flying operations, maintenance, passenger service, and air traffic. The remaining costs are classified as fixed: depreciation, general and administrative costs, and traffic related expenses. It should be noted that the ratio of fixed costs to operating revenues (%F/R) for the carriers in the study was typically in the mid-20% range.[7] While this ratio is not as high as in some of the classic fixed-cost industries such as auto manufacturing, it does indicate that fixed costs are a significant factor in the airline industry.

The tables show computed leverage measures for each of the airlines, as well as rates of return on assets and return on equity. Charts I-III show graphically the computed DOL, DFL, and DCL values that appear in the tables.

Before discussing in detail the implications of the tables, several preparatory comments may be helpful. It is important note that the sign, as well as the magnitude, of DOL, DFL and DCL are both significant indicators of risk. If operating revenue (R) exceeds the sum of variable plus fixed costs (V+F), then the carrier is operating above its break-even point and DOL will be positive. This means that if revenues increase (decrease), operating profits will increase (decrease) as well. In general, when R>V+F, DOL will take on values of $+\infty$ to +1. Low DOLs indicate a relatively low level of business risk— that is, a low volatility of EBIT as revenues change. The value of (V+F) will exceed R when the carrier is below its operating break-even point. In this case, DOL is negative and can range from $-\infty$ and 0. The negative sign simply means that as R increases, profits increase (that is, losses decrease). Large negative values of DOL indicate greater variability, but very **low** values are far more threatening. The reason is that, in such a case, the loss base is very large and the carrier is far below its break-even point. The same is true for DFL and DCL. As a final note, it should be pointed out that if either DOL or DFL is negative, or if both are negative, DCL will be negative.

A comparison of the derived leverage measures for the three carriers is revealing. The contrast between SWA's figures and those of the other two carriers is especially telling. It's clear, for example, that SWA shows far more stable DOL values than the other carriers. Recall that DOL measures the relative volatility in EBIT given changes in revenues. As a case in point, in 1997 SWA's EBIT changed by only 3.2% for each 1%

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[7] It should be noted that fuel, a classic variable cost, behaves in a constant or step-variable manner. That is, it is a "sticky" cost in the economic sense. As traffic declines, fuel costs cannot be cut immediately in response. The first to recognize this behavior was Caves. See: Richard Caves, **Air Transport and Its Regulators**, (Cambridge, MA:The Harvard University Press, 1962), 82. To the extent that this is true, our analysis would tend to understate the true impact of leverage.

change in revenues. With the exception of 1990 (when DOL was 11.1), the carrier's stability is remarkable. In general, SWA has maintained an industry-low cost-per-available-seat-mile ratio (usually in the neighborhood of $.073-$.075 per ASM). The airline's operating strategy of point-to-point service, use of one aircraft type (the B737), and its selective market penetration has certainly been validated by its performance. Perhaps most remarkable and most relevant to our study, however, is SWA's aversion to long-term debt finance. As evident from Table I, SWA's debt/equity ratio has frequently been below the 1:1 standard used by most bankers, and is the lowest of the major carriers by a considerable measure. The low DFLs are evidence of the resulting stability. Add to this the fact that the carrier's DCLs have been the industry's most stable.

USAir shows a distinctly contrasting pattern. While its leverage measures were generally favorable throughout most of the 1980s, the carrier expanded rapidly in the late 1980s and chose to finance much of this expansion with debt. The adverse effects of this decision can be seen in the table. Operating below its break-even point (which is evidenced by the negative DOLs), USAir found its problems compounded by its excessive debt finance (its debt/equity ratio reached 5.8 in 1994). The carrier was heavily stressed and faced the very real prospect of failure in the early part of this decade. Fortunately, the economic boom provided some relief in 1996 -1997.

Delta, the third carrier in the study, offers a curious, perhaps less-definitive case. While its overall performance and financial strength have placed the carrier among the leaders in the industry, Delta's DOLs have been significantly higher than those of SWA over the 19-year period of the study. In some cases, these DOLs have been negative. In spite of this higher business risk, however, the carrier has often resorted to the use of large amounts of debt finance. (The exception was in the mid-1980s period and during the last several years-- years in which the carrier's profitability has been helped by that strategy, the direct result of the positive magnification caused by debt.) DAL's DFL measures have, in some years, also been negative, and the effects on DCLs, especially in the period 1990-1994, have been quite severe. Although the record profits earned by the carrier in the last two or three years have returned Delta to a more stable footing, it is notable that such a dominant player in the industry has experienced such sharp fluctuations in its profitability.[8]

As noted, higher degrees of operating leverage will result in less stable pre-tax returns on assets (ROA). The upper section of Table IV shows the mean returns for all the major air carriers for the 1979-1997 period, as well as the standard deviations around those means. To better enable comparisons, the coefficient of variation (CV, or the standard deviation divided by the mean), and the range are also provided. Once again, SWA clearly stands out. Not only does SWA show the highest average ROA (9.93%) for the horizon of the study, but its CV (.406) is the lowest. (Delta's average ROA is 3.58%, with a CV of 1.61; USAir's ROA is 4.45%, with a CV of 1.60.)

[8] This carrier has been typical of several of the other healthier carriers, such as American and United. See: Gritta, et. al., "Measuring the Effects of Operating, ...," Transportation Law Journal, especially Table VII.

The figures at the bottom of Table IV suggest the impact of debt. Financial risk has been defined as the added or incremental variability in returns to equity (ROE), given changes in ROA. Increased risk can been seen in the incremental CV values (Δ CV). SWA's average 18.03% ROE is the highest of the carriers and its CV the lowest (.545). More importantly, its incremental CV is quite small when compared to the other carriers, increasing from .406 to .545, or Δ.139. Delta's average return on equity is only 2.73%, and the incremental change in Delta's CV is high, increasing from 1.60 to 8.06, or Δ7.46. USAir has a negative average ROE (-22.58%), with a CV that changes from 1.61 to -3.28. (It is worth noting that if one were to look at data for all the major carriers, one would see that all but SWA show large incremental changes in CV values, accompanied by wide spreads (ranges) between high and low returns over the period of the study.)

Conclusions:

In this paper, operating and financial data for three major air carriers were examined to identify the effects of varying leverage positions on airline profitability over time. Three types of risk were defined: business risk, financial risk, and combined risk. Measures of risk and return for the three major carriers selected were computed for the period 1979-1997.

It has been argued that business and financial risk interact in a multiplicative fashion. The effect of this interaction can be highly volatile profit levels for those who mix high levels of debt finance (financial risk) with high levels of business risk, especially in an industry with the structure and competitive characteristics of the airline industry. The results of our analysis validate the sound principle of finance which holds that firms high in business risk should avoid excessive debt finance. SWA, generally recognized as a model of sound financial policy within the airline industry, has consistently followed this principle. In contrast, the performance of USAir over the period of the study serves to demonstrate that the penalty for violating this principle can be severe.

While the aggressive, high-leverage financial strategies of some carriers have served to enhance profitability in the current favorable economic climate, the overriding lessons of the not-so-distant past need to be remembered. The profitability of the airline industry is very fragile. Should fuel and interest costs increase, or should demand decrease, the dangers of over-leverage will surely be revisited.

TABLE I (A)

SOUTHWEST

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Revenues	78,165	213,048	270,358	331,189	448,237	536,976	606,095	619,711		860,447
Var Costs	48,391	125,901	174,794	220,732	275,758	347,474	380,411	359,689		494,496
Fix. Costs	14,174	38,290	47,061	71,233	103,922	119,856	155,392	178,676		209,871
EBIT	15,601	48,829	48,504	39,225	68,557	68,646	70,290	81,346		86,079
Interest	4,939	9,144	10,057	7,729	12,184	15,901	20,125	27,201		29,221
PROFIT	10,662	39,685	38,447	31,496	56,373	52,745	50,165	54,145		56,858
DOL	1.9	1.8	2.0	2.8	2.5	2.7	3.2	3.2		2.3
DFL	1.5	1.2	1.3	1.2	1.2	1.3	1.4	1.5		1.5
CL	2.8	2.2	2.5	3.5	3.1	3.5	4.5	4.8		3.5
FC/REV	0.181	0.180	0.174	0.215	0.232	0.223	0.256	0.288		0.244
ROA	0.090	0.218	0.166	0.093	0.117	0.107	0.077	0.084		0.066
ROE	0.183	0.371	0.218	0.131	0.388	0.358	0.108	0.107		0.101
DEBT/EQ'T	1.953	1.098	0.653	0.748	3.033	3.366	0.978	0.915		1.314

	1989	1990	1991	1992	1993	1994	1995	1996	1997
Revenues	1,015,124	1,186,831	1,313,677	1,685,250	2,067,371	2,418,583	2,873,482	3,407,361	3,816,997
Var Costs	603,032	753,373	857,214	1,009,341	1,173,885	1,390,502	1,726,283	2,021,408	2,142,839
Fix. Costs	314,518	394,419	351,843	494,127	612,250	736,123	858,651	1,036,225	1,149,836
EBIT	97,575	81,616	62,043	181,783	281,236	289,938	308,548	349,728	524,322
Interest	33,550	32,003	43,942	58,939	55,451	52,446	58,184	58,377	62,814
PROFIT	64,025	49,613	18,101	122,844	225,785	237,492	250,364	291,351	461,508
DOL	4.2	11.1	4.4	3.7	3.2	3.5	4.0	4.0	3.2
DFL	1.5	1.6	3.4	1.5	1.2	1.2	1.2	1.2	1.1
CL	6.4	18.3	15.0	5.5	4.0	4.3	4.9	4.8	3.6
FC/REV	0.310	0.332	0.268	0.293	0.296	0.304	0.299	0.304	0.301
ROA	0.069	0.056	0.034	0.079	0.116	0.103	0.095	0.094	0.123
ROE	0.109	0.082	0.029	0.144	0.221	0.192	0.175	0.177	0.153
DEBT/EQ'T	1.408	1.417	1.911	1.681	1.371	1.269	1.283	1.259	0.411

TABLE I (B)

SOUTHWEST

FIXED COST, VARIABLE COST BREAKDOWNS

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
VARIABLE COSTS																			
FLYING OPERATIONS	29,864	75,994	110,610	134,937	161,411	198,874	203,653	164,939		237,150	284,473	388,309	420,551	484,292	559,666	652,763	841,228	1,007,936	1,061,026
MAINTENANCE	5,176	15,510	20,039	25,255	28,523	43,054	53,349	56,977		77,749	102,667	114,267	135,036	169,405	194,586	239,558	286,514	339,423	353,869
PASSENGER SERVICE	3,179	7,510	11,390	17,065	24,761	31,763	38,098	46,911		57,085	65,549	72,080	87,996	101,043	122,618	146,248	188,392	192,616	204,547
AIR/TRAFFIC SERVICE	10,172	26,887	32,755	43,475	61,063	73,783	85,311	90,862		122,512	150,343	178,717	213,631	254,601	297,015	351,933	410,149	481,433	523,397
TOTAL VAR COSTS	48,391	125,901	174,794	220,732	275,758	347,474	380,411	359,689		494,496	603,032	753,373	857,214	1,009,341	1,173,885	1,390,502	1,726,283	2,021,408	2,142,839
FIXED COSTS																			
PROMO/SALES	5496	15490	19556	33796	51306	59706	81371	91072		131546	145110	190,271	164,148	234,874	299,536	390,608	440,621	511,135	538,228
G&A	3047	8525	9629	12423	18588	20118	24588	29768		7717	91676	111,521	102,704	151,198	190,057	205,279	255,438	334,702	402,546
DEPREC/AMORT	4571	12144	15303	21677	29853	34940	45624	55644		66169	72469	86,202	79,429	101,188	114,525	130,115	151,226	177,498	195,197
TRANSPORT REL	1060	2131	2573	3337	4175	5092	3809	2192		4439	5263	6,425	5,562	6,867	8,132	10,121	11,366	12,890	13,865
TOTAL FIXED COSTS	14174	38290	47061	71233	103922	119856	155392	178676		209871	314518	394419	351843	494127	612250	736123	858651	1036225	1149836

TABLE II (A)

USAir

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Revenues	728,710	971,825	1,110,491	1,273,012	1,432,264	1,629,696	1,749,126	1,786,958	2,070,312	2,802,994	4,204,661	6,084,704	6,049,170	6,235,622	6,623,049	6,578,593	6,984,876	7,704,057	8,501,485
Var Costs	529,762	694,598	826,367	921,650	1,008,219	1,105,065	1,177,583	1,176,797	1,260,781	1,905,317	3,186,316	4,922,264	4,564,319	4,843,017	4,930,440	4,998,599	4,726,464	5,037,686	5,234,823
Fix. Costs	146,949	185,840	225,655	272,026	295,174	331,907	404,621	446,028	526,574	753,949	1,246,439	1,711,035	1,686,952	1,768,150	1,820,539	2,085,169	2,023,761	2,297,703	2,680,512
EBIT	51,939	91,387	58,469	79,336	128,871	192,724	166,922	164,133	263,457	143,728	-228,094	-543,235	-202,101	-375,545	-128,740	-505,145	234,651	368,668	586,150
Interest	14,701	21,614	22,660	30,412	29,583	27,557	36,239	40,069	37,458	55,594	87,221	139,641	178,113	196,761	219,418	273,095	294,081	264,184	255,882
PROFIT	37,238	69,773	35,809	48,924	99,288	165,167	130,683	124,064	225,999	88,134	-315,315	-682,876	-380,214	-572,306	-348,158	-778,240	-59,430	104,484	330,268
DOL	3.8	3.0	4.9	4.4	3.3	2.7	3.4	3.7	2.9	6.2	-4.5	-2.1	-7.3	-3.7	-13.2	-3.1	9.6	7.2	5.6
DFL	1.4	1.3	1.6	1.6	1.3	1.2	1.3	1.3	1.2	1.6	-0.7	-0.8	-0.5	-0.7	-0.4	-0.6	-3.9	3.5	1.8
CL	5.3	4.0	7.9	7.2	4.3	3.2	4.4	4.9	3.3	10.2	-3.2	-1.7	-3.9	-2.4	-4.9	-2.0	-38.0	25.5	9.9
FC/REV	0.202	0.191	0.203	0.214	0.206	0.204	0.231	0.250	0.254	0.269	0.296	0.281	0.279	0.284	0.275	0.317	0.290	0.298	0.315
ROA	0.097	0.128	0.066	0.075	0.107	0.138	0.098	0.088	0.147	0.050	-0.038	-0.084	-0.031	-0.056	-0.019	-0.076	0.034	0.050	0.071
ROE	0.173	0.257	0.101	0.107	0.181	0.249	0.170	0.145	0.314	0.079	-0.112	-0.287	-0.181	-0.664	-0.853	-2.849	-0.191	-1.227	0.300
DEBT/EQ'T	1.473	1.631	1.494	1.314	1.206	1.109	1.201	1.170	1.494	1.588	1.155	1.721	2.135	6.794	15.688	-25.438	-22.928	-88.015	6.502

TABLE II (B)

USAir

FIXED COST, VARIABLE COST BREAKDOWN

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
VARIABLE COSTS											
FLYING OPERATIONS	525,803	786,620	1,320,534	2,209,902	1,978,356	2,069,689	2,047,017	2,138,550	1,964,798	2,171,104	2,247,492
MAINTENANCE	208,470	342,910	576,010	797,874	768,929	768,170	813,723	847,552	797,449	823,982	935,609
PASSENGER SERVICE	192,019	276,217	495,243	694,792	700,608	749,104	714,873	694,210	658,054	693,209	710,208
AIR/TRAFFIC SERVICE	334,489	499,570	794,529	1,219,696	1,116,426	1,256,054	1,354,827	1,318,287	1,306,163	1,349,391	1,341,514
TOTAL-VAR COSTS	1,260,781	1,905,317	3,186,316	4,922,264	4,564,319	4,843,017	4,930,440	4,998,599	4,726,464	5,037,686	5,234,823
FIXED COSTS											
PROMO/SALES	335,808	474,027	771,924	1,045,112	1,096,371	1,127,330	1,147,491	1,191,999	1,169,163	1,290,029	1,322,533
G&A	84,996	141,652	250,874	303,179	254,950	260,171	243,039	253,182	277,192	361,776	287,021
DEPREC/AMORT	87,164	112,811	183,827	312,518	282,538	300,176	292,094	462,358	351,067	314,375	395,355
TRANSPORT REL	18,606	25,459	39,814	50,226	53,093	80,473	137,915	177,630	226,339	331,523	675,603
TOTAL FIXED COSTS	526,574	753,949	1,246,439	1,711,035	1,686,952	1,768,150	1,820,539	2,085,169	2,023,761	2,297,703	2,680,512

TABLE III (A)

DELTA

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Revenues	2,672,068	3,301,917	3,644,208	3,631,792	3,905,159	4,496,735	4,738,168	4,496,044	6,093,331	7,393,275	8,648,315	8,746,083	10,062,871	11,639,080	12,375,559	12,345,784	12,557,276	13,317,693	14,203,939
Var Costs	1,943,890	2,427,289	2,749,337	2,783,135	2,856,267	2,967,116	2,586,783	2,973,967	4,041,689	4,823,113	5,449,321	6,366,071	7,213,193	8,776,603	8,749,360	8,457,295	7,987,642	8,498,213	8,679,326
Fix. Costs	604,475	710,449	808,372	934,605	1,106,099	1,242,275	1,920,178	1,297,074	1,617,399	2,045,125	2,523,139	2,615,140	3,116,211	3,688,025	3,901,207	4,103,399	3,551,207	4,248,367	3,906,336
EBIT	123,703	164,179	86,505	-85,948	-57,207	287,344	231,207	225,003	434,243	524,637	676,550	-235,128	-266,535	-825,508	-274,908	-215,110	1,038,427	571,113	1,621,277
Interest	18,879	22,159	36,022	76,866	113,609	114,461	56,046	71,493	91,577	80,448	65,571	94,347	170,200	212,843	260,349	269,660	250,480	217,242	195,773
PROFIT	104,824	142,020	50,483	-162,814	-170,816	172,883	175,161	153,510	342,666	444,189	610,979	-329,475	-436,735	-1,038,351	-535,257	-484,770	787,947	353,871	1,425,504
DOL	5.9	5.3	10.3	-9.9	-18.3	5.3	9.3	6.8	4.7	4.9	4.7	-10.1	-10.7	-3.5	-13.2	-18.1	4.5	8.4	3.4
DFL	1.2	1.2	1.7	-0.5	-0.3	1.7	1.3	1.5	1.3	1.2	1.1	-0.7	-0.6	-0.8	-0.5	-0.4	1.3	1.6	1.1
CL	6.9	6.2	17.7	-5.2	-6.1	8.8	12.3	9.9	6.0	5.8	5.2	-7.2	-6.5	-2.8	-6.8	-8.0	5.9	13.6	3.9
FC/REV	0.226	0.215	0.222	0.257	0.283	0.276	0.405	0.288	0.265	0.277	0.292	0.299	0.310	0.317	0.315	0.332	0.283	0.319	0.275
ROA	0.065	0.076	0.035	-0.030	-0.018	0.086	0.065	0.053	0.080	0.090	0.102	-0.032	-0.029	-0.081	-0.024	-0.019	0.087	0.048	0.124
ROE	0.120	0.145	0.049	-0.166	-0.182	0.147	0.134	0.082	0.167	0.188	0.211	-0.154	-0.188	-0.370	-0.283	-0.292	0.370	0.139	0.405
DEBT/EQ'T	1.176	1.205	1.353	1.942	2.441	1.833	1.721	1.274	1.627	1.455	1.294	2.487	2.911	2.650	5.164	5.830	4.601	3.705	2.727

TABLE III (B)

DELTA

FIXED COST, VARIABLE COST BREAKDOWN

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
VARIABLE COSTS											
FLYING OPERATIONS	1788939	2095694	2397620	2978768	3223662	3807662	3848671	3553575	3588487	4125621	3884539
MAINTENANCE	512861	630364	679940	785979	960996	1196472	1158437	1120844	990553	974682	1114795
PASSENGER SERVICE	670194	820134	919194	1007606	1174970	1462202	1444267	1422123	1255749	1301546	1427976
AIR/TRAFFIC SERVICE	1069695	1276921	1452567	1593718	1853565	2310267	2297985	2360753	2152853	2096364	2252016
TOTAL VAR COSTS	4041689	4823113	5449321	6366071	7213193	8776603	8749360	8457295	7987642	8498213	8679326
FIXED COSTS											
PROMO/SALES	1086795	1369591	1627591	1773466	2194512	2544069	2701550	2641792	2252069	2244990	2296239
G&A	184903	231536	390142	315299	317965	363327	373343	463814	369081	516531	574058
DEPREC/AMORT	305570	374526	428800	487725	560591	720705	745560	849686	623343	1121448	778187
TRANSPORT REL	40131	69472	76606	38650	43143	59924	80754	148107	306714	365398	257852
TOTAL FIXED COSTS	1617399	2045125	2523139	2615140	3116211	3688025	3901207	4103399	3551207	4248367	3906336

TABLE IV

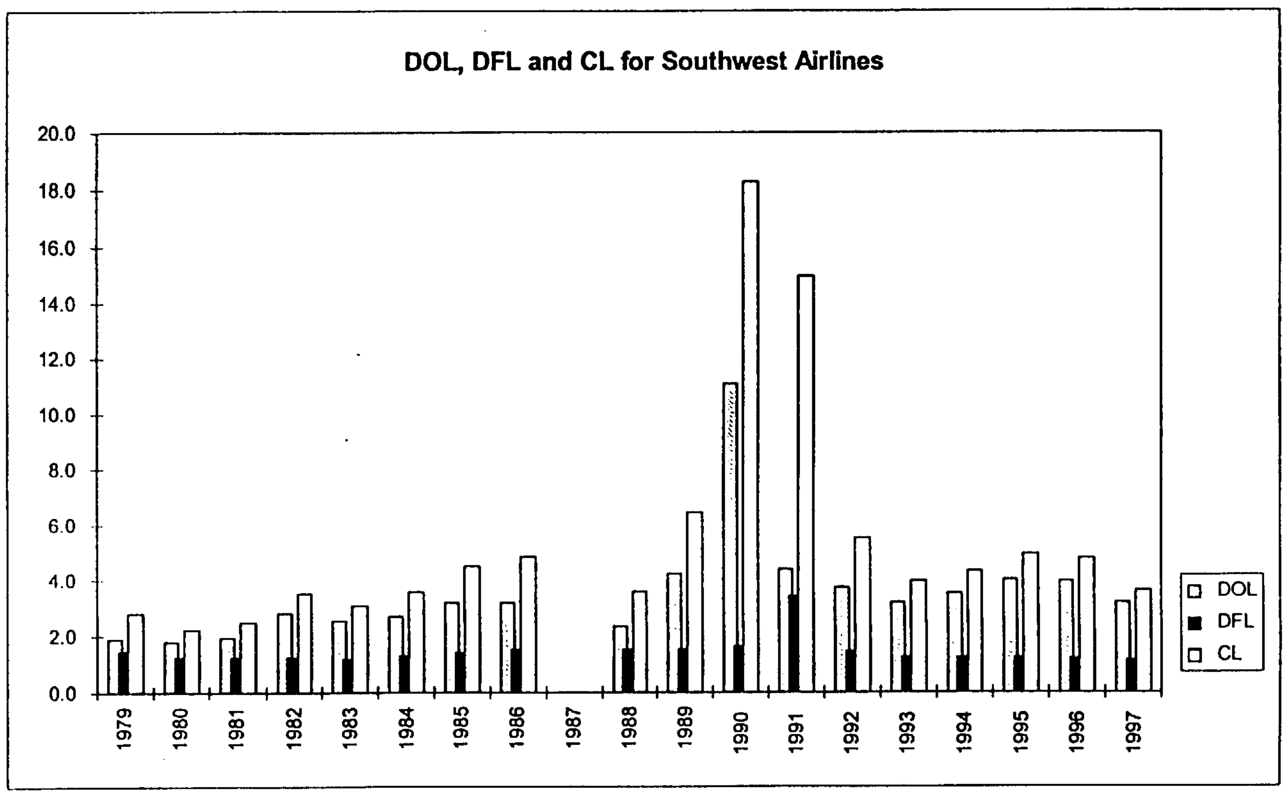
ROA

	MEAN	STD DEV	Coeff of Var (CV)	RANGE	
Delta	3.58%	5.71%	1.60	-8.07%	12.36%
Southwest	9.93%	4.03%	0.41	3.37%	21.76%
USAir	4.45%	7.15%	1.61	-8.39%	14.69%

ROE

	MEAN	STD DEV	Coeff of Var (CV)	RANGE	
Delta	2.73%	22.00%	8.06	-37.02%	40.51%
Southwest	18.03%	9.83%	0.54	2.87%	38.84%
USAir	-22.58%	74.13%	-3.28	-284.88%	31.43%

CHART I


DOL, DFL and CL for Southwest Airlines
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18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
DOL
DFL
CL

CHART II

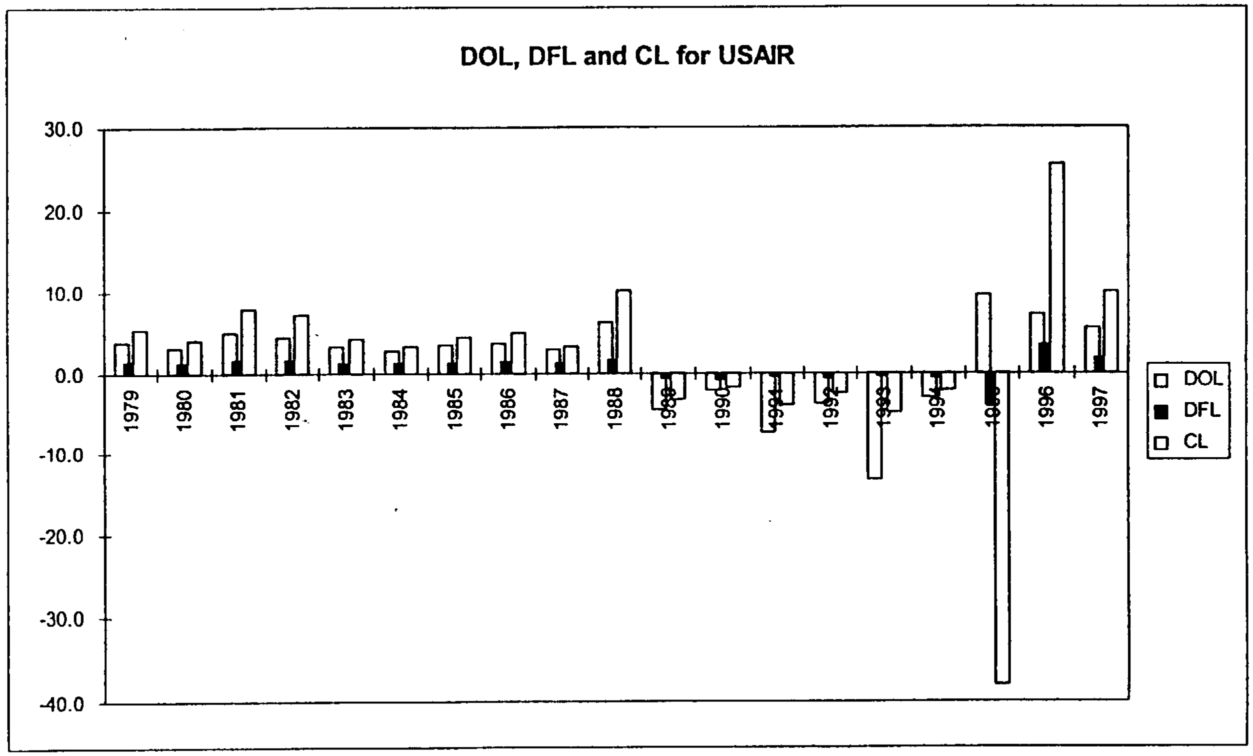
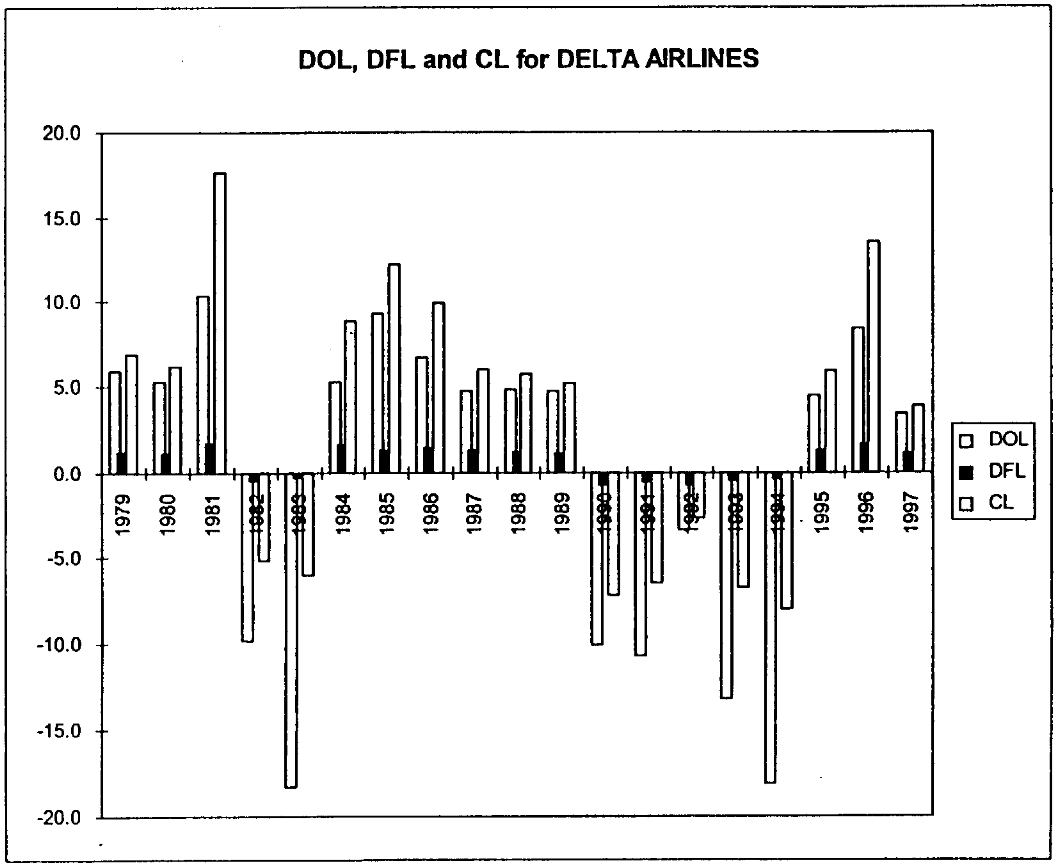

DOL, DFL and CL for USAIR
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1990
1996
1997
DOL
DFL
CL

CHART III


DOL, DFL and CL for DELTA AIRLINES
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10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
1979
1980
1981
1984
1985
1986
1987
1988
1989
1995
1996
1997
DOL
DFL
CL

A Factor Analytical Study of Airline Management: The Case of New Entrant Airlines

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Management is usually considered the single most important determinant of the firm's success or failure. However, an overall approach to classify underlying factors of management characteristics has been lacking in airline research, making it difficult to select and associate constructs when researching management performance through qualitative instruments. This paper determines through exploratory factor analysis such underlying factors characterizing new entrant airlines. The determinant factors are then used to test, through regression analysis, the relationship of conceptually based critical performance factors with performance indicators and environmental influence factors. The study is longitudinal, based on a survey among new-entrant airlines, performed first in 1993 and then repeated in 1998/99.

Hermann Korn, having survived with a friend, Hanno Martin, for years in total isolation in one of the most hostile environments on Earth the Namib Desert, came to the conclusion (Martin, 1970) that 'Any form of life which insulates itself too successfully against pain fails to notice change in its environment until it is too late.' This is in no doubt the fallacy of many managers rising to prominent positions within corporations, experiencing an element of surprise when market-share starts to erode in a growth market, profit-levels drop or other indicators of declining performance start to emerge. To take the pulse by 'wandering about' your company, to experience your competitor's products and to 'listen', can never be overemphasized as means for feedback on performance. To identify formal performance indicators further down the line is, however, a source of debate as to what indicators provide the most effective feedback. Eccles (1991) argued that alternative methods of performance measurement was needed, stressing the point that traditional financial performance indicators are too simplistic and backwardly orientated to serve their purpose. Whether a contingency approach or a more lucid structured approach should be used instead of the traditional financial indicators remains a question in the general approach to performance measurement.

Controversy arises as we move away from financial devices towards more 'qualitative' measuring devices. Various research on poor corporate performance places blame on the managers above most other factors without having an uniformly explanatory and acceptable framework of management performance measurement. Leaving us the question 'what constitutes poor management' and hence 'what causes poor management'. Leaving the first question aside at the moment, the answer to the latter question has to lie in the psychic of the manager, as a finding by Dun & Braadstreet (1980) suggests. The study found that 44 percent of corporate failures are linked with 'inexperience, unbalanced experience or incompetence of managers'. As a student of corporate performance leaning towards the failure phenomena I have found the managers' psychic is a troubled area for constituting relationships with corporate performance. As a result, it started to emerge that in performance analysis of corporations it would be more effective to concentrate on management actions i.e. 'what happens if I take action X on variable A?', rather than asking whether experience, education or any other psychic factors influenced the action taken. To substantiate this point further, we can agree that corporations are constantly facing new situations calling for new ways of action, consequently there will always be an element trial and error. Putting it in an other way we can assume a crystallized element (I know what happens when I apply action X on A, because I have done it before) or a post-trial experience in change processes and a fluid element (uncertainty or risk awareness associated with the unknown) based on intuition about 'what I assume will happen if I apply action X on A, although I have not done it before'. Albeit a worthwhile research area I came to the conclusion that the first step would be to depict a performance measurement method dealing with 'what happens when action X is taken on A' and define 'poor management' as 'obviously wrong action on a variable given the crystalized

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element in the decision-making, but not the fluid element. This effectively means that 'errors' are assumed to be part of the change process and should therefore not be associated with 'poor management', given that risk management is part of the crystallized knowledge base, i.e. 'you do not place all you apples in the same basked' as an underlying anecdote. As a result the attention is moved towards the change process rather than the managers' persona as such in determining 'causes' of variation in corporate performance.

Turning to the unanswered question 'What constitutes poor performance' we can not make the assumption that most managers at poorly performing companies are poor managers or vice versa. The envelope of factors associated with the concept of good or bad management is just too great, dynamic and subject to fashions of the time. Hence, we should focus on the process itself and the factors that the manager can actually handle in order to cause change to the better. Logically this will shift the attention from performance indicators of financial orientation towards integrative decision-making involving one or more factors that can be manipulated to cause change in the performance of the organization.

The Concept of Critical Performance Factors

In the past various concepts have emerged to assist in the analysis of corporate performance. For example, the concept of Critical Success Factors (CSF) used as the basis for management information systems planning (Boynton & Zmud, 1984; Rockart, 1979; Daniel, 1961) and now increasingly in strategy formulation (King & Zmud, 1982; Hardaker & Ward, 1987). Although the concept has been found useful for MIS planning (Martin, 1982) and reliable as technique (Munro, 1983), concern has been voiced relating to the complexity of the attitude measurements and the inability of managers to deal with complexity, bias by recent events, bias caused by manager's and analysts, and also that CSF's may not represent causal relationships (Davis, 1979, 1980). Various other questions arise namely whether an organization in a state of decline should be emphasizing the same 'Critical Success Factors' as an organization doing very well. The complexity must surely be greater than implied allowing us to propose caution as to the validity of CSF's for organizations across industries and even when applied to individual companies with diverse financial performance within an industry sector.

An other more conceptual approach to performance analysis was the segregation of causes from the symptoms of failure, proposed by Argenti (1976). The proposition has been much cited in the literature dealing with corporate failure, but has lacked in terms of further development and empirical investigation.

In this research a concept of *Critical Performance Factors* (CPF) is proposed (*see* Figure 1), aimed at identifying factors that are influential on the organization's performance taking into account some of the limitations of available concepts in qualitative performance analysis.

Although Argenti (1976) pointed out the distinction between the causes and symptoms of corporate collapse[2] there is a lack of structure as to how to distinguish the causal factors effectively from the symptoms, an issue which the CPF concept covers, namely by assuming that the factor must be manipulatable and therefore directly changeable by management.

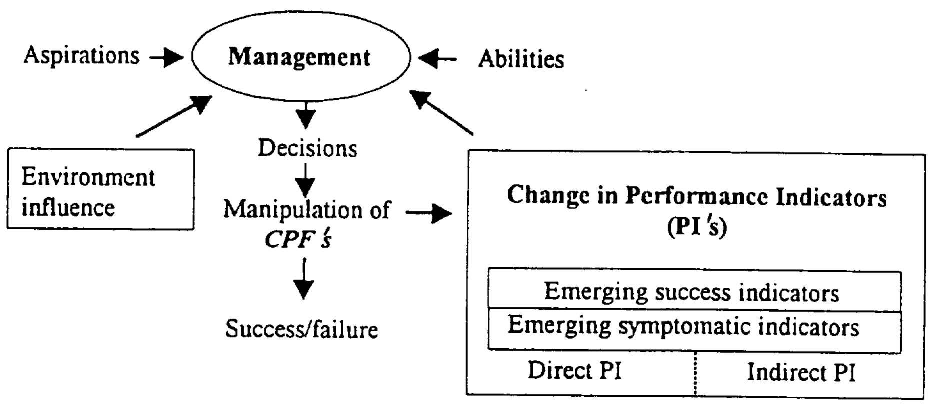
Factors identified as CSFs may differ according to the performance level of the organization necessitating segregation of terms i.e. success vs. failure factors. In this respect one can revisit Maslow's hierarchy of needs (Maslow, 1943) and project that organizations struggling for survival will be more prone to pay attention to basic needs while those considered highly successful will be occupied by self-actualization. Although, this example is not an attempt to suggest or prove that Maslow's theory can be adopted to organizational behavior, it is however a convenient framework to point out why there may be an important difference in identified CSFs according to organizational performance level. To put the argument further, a study was carried out by Kr垄er (1989), covering 96 successful and unsuccessful companies, to explain success and failure of companies. He came to the

[2] Argenti's findings have been criticized due to their lack of research backing. D'Aveni (1989) concludes that Argenti's findings may not necessarily be defective but, nevertheless, in a need of confirmation and further development. It must be recognized however that even though a conceptual framework explaining corporate failure and success is much needed, Argenti's work as such may be considered to be an important step in that direction. The basic idea that analysts need to distinguish between causal versus reactive factors in the system must therefore be integrated into a framework supposed to identify true causal impact of actions on management tools i.e. CPFs.

conclusion that fewer factors were cited as success factors than failure factors and success factors and failure factors were not necessarily the same. This being the case it may be more important to identify CPFs linked to failure in organizations having difficulties, than to identify the factors linked to success. Thus, enhancing the organization's attention to what is needed rather than what is fashionable at the time. When the organization has gained control over its destiny by manipulating the failure linked CPFs successfully it can start to identify the success linked CPFs.

The third assumption must be adopted in order to reduce the manager's and researcher's bias. If the factor can differentiate statistically a dichotomous performance state of the organization or its sub-components the factor has consequently a value approaching the *critical*. Due to the complexity of organizations the identification of CPFs is subject to fads of the period[3] and the possibility of looking at factors in isolation[4] or even mixing together causal and reactive factors. Thus the factors generated must be tested against a dichotomous performance state for a large sample of organizations in order to identify a statistically significant difference in management emphasis on relevant factors.

Figure 1
The Concept of Critical Performance Factors



Following what has been suggested so far we can postulate that Critical Performance Factors (CPF) are factors that are directly controlled by manipulation. There are of course additional factors, firstly those related to the external environment that cannot be influenced (by a single company in ordinary circumstances), and secondly factors that affect the quality of management decisions. As we covered earlier we can agree that management ability will affect management actions. The problem is, however, how management ability can be measured. Many would mention education, experience and so forth. The problem arises when we observe inexperienced managers with basic education that excel in their management responsibilities. Thus, it is, as discussed before, well founded that the only true measurement of management abilities is how the manager applies his decision-making capacity vested in his position within the firm to various factors that can be directly manipulated. Decision making involving these factors then collectively becomes the true cause of the corporations' destine. As a result, any research dealing with the causes of corporate success or failure has to identify the CPFs, the factors that really constitute change (to the better or the worse) in the organization. Critical Performance Factors can therefore be defined as: *those factors that can be directly altered by management decisions resulting in, either individually or collectively, performance change of the whole organization or any of its sub-components*. In other words CPF are true causal factors that can be statistically associated with the dichotomous performance state of the organization.

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[3] See a good account on this issue in: Abrahamson, 1996.
[4] To attach too much meaning to a single factor as a causality in a complex system.

Having made this distinction between CPF and performance indicators according to the CPF method, one needs to decide where to place the business environment. Because the manager has no control over the environment variables (generally speaking) and can consequently not manipulate environment factors as CPF, leads to the conclusion that the environment can be neither CPF (causal) nor a PI according to the framework.

If the environment factors can not be adjusted by the management there are consequently not going to be any symptomatic or success PIs associated with the environment variables. One can nevertheless not ignore that the external environment is often cited as a contributor to fluctuations in the failure rate of companies (Goudie & Meeks, 1991; Desai & Montes, 1982) and as a cause (Newton, 1985). Nevertheless, it is argued here that the external environment can only pose influence on the manager's decision-making, while the actual cause will always rest with the application or non-application of the CPFs available to managers. Only will the environment become a CPF when the firm can influence the environment to its benefit, like securing favorable treatment or monopolies from the Government. An example of such a situation would be when the industrialist Ivan Kreuger provided large loans to various governments around Europe in the 1920's, to secure monopolies in the match market (Management Today, 1997). One must assume that most firms are not in such a position, while the availability of a management tool of such caliber today is probably linked to the firm reaching such a size that its well-being becomes of a national importance. For majority of firms the environment poses constraints at its worst, that result in the necessity to apply the CPFs if the firm's well-being and economic rent is to be secured. It is certainly not unknown that firm's have been under such intensive environment constraints that the only possible decision is to pull out of markets.

To illustrate the CPF concept we can take an example (*see* Figure 2): managers of an airline can increase flight frequency in an attempt to improve the profitability of a specific route. Such change in the causal factor flight frequency' (CPF) can affect the airline in a number of ways that appear as changes in performance indicators (PI). Performance Indicators are not causal but symptomatic factors that can take two states depending on where the manipulation of the CPF is taking the organization *i.e.*, to a symptomatic or success state. If we examine the negative effects we might see deteriorating load-factor and REVEX ratio. In other words an emerging symptomatic state of PIs, while movement in the other direction would constitute an emerging success state of PIs. Taking this example further we can infer that a change in load-factor is a *direct* PI, while a change in the REVEX ratio would be considered *indirect* PI. This stems from the fact that profitability as such is a collective measurement of all activities within the company, while a change in load-factor on a single route can be traced directly to manipulation of the CPF route frequency.

It must be made clear, however, that negative manipulation (poor application) of CPF or even inactivity can lead to misleading positive effects on the PIs, that is make them appear as emerging success indicators. Take for example, a reduction in frequency that causes high load factors (emerging success PI) but poor aircraft utilization, if we assume that the excess of available aircraft hours can not be applied elsewhere in the network. This stems from the fact that there is hardly an increase in the overall number of passengers wishing to fly on the route when frequency is reduced, in fact there is usually a reduction as fewer passengers will find convenient flights, causing defection to the competitors or other transport modes. If the aircraft hours reduced can not be applied elsewhere the end result will be lesser aircraft utilization at a greater cost than the benefits from an increase in load-factor[5].

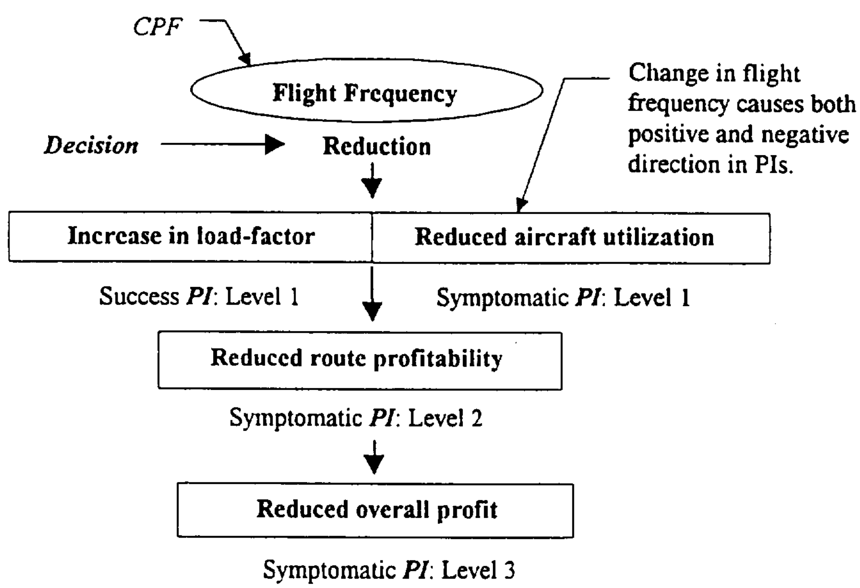
The higher the level of a PI (*i.e.* further from the CPF) the more general and important it is in terms of indicating the overall performance of the firm. Therefore, it follows that the causal relationship becomes more complex as the level of the PI is higher. However, it is important to emphasize that CPFs are all one level factors accessible to management like a keyboard on a piano is to the player.

Looking at the literature in search for parallel we will see that frequently cited causes for corporate failure are: *poor financial information* (Clutterbuck, et al. 1990) *lack of control* (Clutterbuck, et al. 1990; Slatter, 1984; Buccino, 1991), *insufficient working capital*

[5] It is well known in the airline industry that aircraft utilization is of an out most importance due to the high fixed costs associated with the aircraft. Thus, an airline operating once a day on a six hour round-trip with 87 percent load-factor and an aircraft on the ground for eighteen hours, is definitely having operational problems and major inefficiencies.

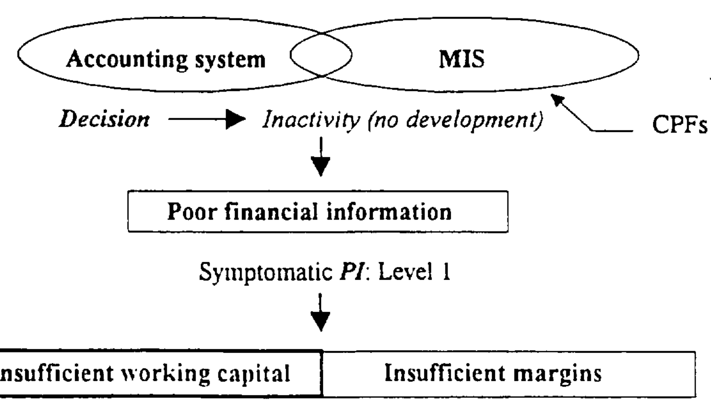
(Clutterbuck *et al*, 1990), *management deficiency* (Slatter, 1984) and *insufficient margins/pricing* (Clutterbuck, et al, 1990; Buccino, 1991; Wood, 1989). Using the *CPF* concept, *insufficient working capital* could be regarded as a symptomatic *PI* stemming from numerous factors, including inadequate accounting and management information system.

Figure 2
Direction and Levels of Performance Indicators



The defective information system then leads to *poor financial information*, a symptomatic *PI* on level 1. *Poor financial information* then impacts symptomatic *PI* on level 2, namely *working capital* and *margins*. In both cases it can be assumed that the latter two PIs are negatively impacted due to inadequate information. The final stage in the *PI - Chain* is overall losses, *symptomatic PI* on level 3.[6] The factors evaluated with the concept of CPF are therefore *symptomatic PIs* rather than causal CPFs. The concept lends itself also well to the analysis of empirical data as the following section shows.

Figure 3
Application of The Concept to Existing Findings



[6] The levels are not necessarily limited to three.

Symptomatic *PI*: Level 2

↓

Losses

Symptomatic *PI*: Level 3

Empirical Identification of Critical Performance Factors

Table 1 shows the results of a research performed on new-entrant airlines in the United States and Europe. The airlines where divided into two groups depending on their performance: distressed if it had made operating losses in the last two years or during any three of the last five years counted from the year of last available financial data, if not the carrier was judged non-distressed.

The factors listed have been divided into two parts, Critical Performance Factors (CPF) and Performance Indicators (PI). The importance of this exertion is to learn first of all whether organizations at different performance levels differ as to the emphasis placed on various factors, and secondly in what direction the difference lies. If there is a statistically significant difference between distressed and non-distressed carriers for that particular factor it can be declared as either CPF or PI, depending on whether the factor is causal or reactive as discussed before.

Table 1
Critical Performance Factors for Airlines

Type	Statement	Group	Mean
CPF +	Expansion into new markets	Distressed	6,450 $^{\Psi}$
		Non-Distressed	7,550
CPF +	Media advertising	Distressed	5,500 **
		Non-Distressed	7,300
CPF +	Cost reduction	Distressed	7,500 *
		Non-Distressed	8,700
CPF -	Hub and spoke operation	Distressed	5,400 *
		Non-Distressed	2,895
CPF -	Job rotation	Distressed	5,800 ***
		Non-Distressed	3,158
CPF -	Alliance with the incumbents	Distressed	5,278 *
		Non-Distressed	3,474
CPF -	Computer reservation system	Distressed	6,600 *
		Non-Distressed	5,167
CPF -	Yield management system	Distressed	5,600 $^{\Psi}$
		Non-Distressed	3,667
CPF -	Merger/acquisition to gain market-share	Distressed	3,947 *
		Non-Distressed	1,941
CPF -	Market-intelligent information- and communication system	Distressed	8,045 *
		Non-Distressed	6,889
CPF -	Off-balance sheet financing of aircraft	Distressed	6,650 $^{\Psi}$
		Non-Distressed	4,765

Note 1: $= p < .001$; $^{**} = p < .01$; $^{*} = p < .05$; $^{\Psi} = p < .1$. The factors were rated on a scale from 0 (no importance) to 10 (most important). *Note 2*: The table is based on the 1993 Survey only.

Source: Gudmundsson, 1998.

On the basis of the direction of the difference it is possible to segregate the CPFs and the PIs into two groups (*see* Table 1), i.e. positive or negative difference for non-distressed carriers. According to the approach positive difference would indicate that the CPF is associated with non-distress, and can therefore be classified as *success factor* (CPF^{+}), while if the difference is in the other direction it would be classified as *failure factor* (CPF^{-}).

It is important to emphasize that the CPFs whether success or failure orientated do not necessarily mean that when a CPF^{-} is emphasized that particular airline is more prone to

failure than an airline not emphasizing the factor. Rather it means that the airlines observed having financial difficulties are more likely to emphasize this factor than an airline not under distress. This can be interpreted in a number of different ways, namely that the airline emphasizes this factor in order to turnaround its fortunes, or it is emphasizing a factor that does adversely influence its well-being. Looking at the PIs a similar pedagogic applies, namely that failure PIs are more important to distressed carriers than non-distressed ones.

Table 2
Performance Indicators for Airlines

Type	Statement	Group	Mean
PI +	Aircraft utilization	Distressed	7,950 $^{\Psi}$
		Non-Distressed	8,850
PI +	Decentralized organization structure	Distressed	6,250 *
		Non-Distressed	4,263
PI +	Brand image	Distressed	5,895 $^{\Psi}$
		Non-Distressed	7,333
PI +	Service quality	Distressed	6,350 *
		Non-Distressed	8,167
PI -	Achieving critical mass	Distressed	6,850 $^{\Psi}$
		Non-Distressed	4,824
PI -	Investors' attitudes towards the new-entrant	Distressed	7,100 *
		Non-Distressed	4,710
PI -	Favorable attitude of travel agents	Distressed	8,300 $^{\Psi}$
		Non-Distressed	7,250

Note: $^{***} = p < .001$; $^{**} = p < .01$; $^{*} = p < .05$; $^{\Psi} = p < .1$.

Source: Gudmundsson, 1998.

METHODS

Analysis

The objective of the analysis was to explore the construct reliability of pre-determined scale divided into three levels according to classification of items into Critical Performance Factors (CPF) on one hand and Performance Indicators (PI) and Environmental Influence (EI) on the other hand. Multiple Linear Regression (MLR) was then used to test hypothesis pertaining to the relationship of first and second order factors.

Population description and response statistics

Questionnaires were used to gather data about the sixty-two component items. The whole world population of 'new-entrant airlines' was identified through the March 1992, and 1997 issues of Flight International that publishes brief historical and contact information for the world airlines. The questionnaires were administered twice once in 1993 to 40 airlines and 242 individuals, and again in 1998 to 60 airlines and 282 individuals. The surveys' mailing strategy was designed in such a way that response rates by airlines would be maximized. This led to an average of 6 mailings to each airline in 1993 and 4.7 in 1998. Response rates by airlines (*see* Table 3) was 65 percent in 1993 and 40 percent in 1998. The lower proportional response rate in 1998 was probably due to a larger number of airlines included located in areas of the world not represented previously. Mean testing was used to assess whether there was difference between the two groups and significant differences were found for ten items and five items that were relevant to the models presented here. These items that are identity marked in the tables (*see* Tables 4 and 5).

Geographical dispersion of mailings in the 98 Survey was ranging from 50% US, 40% EU and 10% other countries, while in the 93 Survey it was 49% US and 51% EU. Another important element was that in the more recent survey about 37% of the airlines have had operating losses for two or more years preceding the survey and are classified as distressed as a result. In the first survey this was different with a major half or 55% being in distress. Age distribution is quite similar for both surveys with most respondents clustering in the 30 to 59 age groups. Education was as expected with most respondents having earned an undergraduate or graduate degree. In the more recent study there were however slightly more respondents in the pilot license group but fewer in the undergraduate group or 35% opposed to 51% in 1993. Job categorization revealed the most dramatic drop in responses from marketing managers, while there was an increase in top managers' and the operations managers' groups.

Data Collection Procedures

The questionnaires for both surveys were almost exactly the same, although the 1998 questionnaire was simplified by eliminating the usage of three time dimensions for the items, which proved to be of limiting value in the previous research. Furthermore, items were added and other eliminated on the basis of factor analytical research. However, in the research presented here items were only considered if they were included in both studies in an unchanged format.

Table 3
Response Statistics

		98 Survey	93 Survey
Response rate by airlines		42% (60/25)	65% (40/26)
Age			
	20 - 29	2	2
	30 - 39	12	12
	40 - 49	12	17
	50 - 59	9	10
	60 - 69	4	2
Education			
	Graduate	14	12
	Undergraduate	14	23
	Some college	3	2
	High school	2	3
	Pilot license	5	2
Job categorization			
	Top managers	9	6
	Marketing managers	2	11
	Operations managers	12	9
	Finance managers	6	6
	Commercial managers	4	0
	Other managers	7	13
Performance status			
	Non-distress	25	20
	Distress	15	25
Geographical dispersion			
	US	20	22
	EU	16	23
	Other	4	0
Total		40	45

Measures

The questionnaire was divided into three parts, with the third part acting as means to classify respondents into various groups. In the research presented here we will only deal with items in part II. In that part the respondents were asked to indicate on a scale of 0 to 10, the 'importance' placed on the items at the airline. The reason for emphasising the rating of 'importance' placed on each factor *at the airline* was to distance the respondent from the terms 'distress' and 'non-distress' and attempt to reveal underlying factors that could be associated with distress and non-distress of new-entrant airlines. This approach was also deemed appropriate in order to prevent the manager from judging his/her own performance, e.g. what importance *should* be placed on the item opposed to what importance *is* placed on the item, as such a measurement is potentially biased, especially, in the face of losses or failure.[7]

The factors in the questionnaire were all developed on the basis of intuition, and literature research (*see* Gudmundsson, 1998) and comments on a pilot questionnaire (conducted as part of the 1993 Survey). The ten point numerical scale is subject to controversy such as most attitude scales. Hoinville and Jowell (1989, p.35) conclude in a widely used book on survey research practice, that much literature is available on the advantages and defects of attitude scaling methods, but

> ...since a rating scale is not an absolute measure of attitude but a way of placing people in relative positions on a dimension, there is no particular way of presenting scales that is intrinsically better than others. The object should be to find the way that discriminates most effectively between respondents.

Having this in mind and the original characteristic of the task (discrimination) the selected scale was considered to suit its purpose well. The questionnaire can be considered to be of medium length, although, the answering process may have placed considerable demand on the respondent's attitude to various issues. However, no statement or factor required information that was necessary to search for in company records. Due to the possible sensitivity of information provided by respondents much emphasis was placed on confidentiality and to identify the questionnaire with a reputable organisation in order to facilitate a sense of security for respondents.

RESULTS OF EXPLORATORY FACTOR ANALYSIS

Descriptive Statistics and Reliability Estimates

Coefficient alpha was used to assess scale reliability for each subscale constructed, based on the latent factors. Reliability for subscales varied for Alpha from (α =.52) to good internal consistency (α = .86). Nunnally (1978) suggested, an alpha of 0.5 or 0.6 being sufficient at the outset of research and all 17 factors extracted met the minimum criteria. One factor had only one item and was as a consequence excluded from further analysis. A number of factors had three items loading but one item with a loading of less than 0.40, such items were deleted from the analysis. This deletion raised the number of factors with two items only from four to six. Spector (1992) argues that factors of less than three items are likely not to be useful. This argument was deemed to be valid in terms of the two item scales needing further development in future research, but not substantiating the deletion of the factors from further consideration.

Measure purification in the construction of theoretical scales was not made into an aim in itself, although correlation matrixes were constructed to see if any of the items used in the scales had non-significant correlation with all of the other items. Nunnally (1978) recommended that items with consistently low correlation (< .30) to be deleted, this led to a number of deletions from the item list. Furthermore, according to Churchill (1979) items with low factor loadings (< .40) were deleted from the analysis.

Models

[7] This believe of managers' willingness to justify their actions or seek explanations from the environment for losses or failure, is clearly apparent from the literature.

The first level exploratory factor analysis (*see* Table 4) was rooted in the CPF analogy and as such is constructed from observed items that can be directly manipulated by airline managers. The factor analysis resulted in 10 factors (*see* Table 4). The first factor was labeled '*service strategy*' (α = .86) explaining 22.4% of the variance and consisting of five items. The name of the factor was based on the items being related with items important to serve business passengers. An airline that is high on this dimension will tend to believe in the importance of high yield passengers. The factor loading ranged from 0.77 to 0.46. The second factor was labeled '*route strategy*' (α = .67) and explains 11.1% of the total variance. This dimension consists of three items with factor loading ranging from 0.88 to 0.42. One item had a loading below 0.40 and was deleted. Items in this factor seemed to measure issues associated with setting up and maintaining efficient routes. An airline that scores high on this factor will tend to believe in the importance of setting up and maintaining efficient route structures with well connected flights. The third factor was labeled '*cost competitiveness*' (α = .69) explained 7.0% of the total variation. This dimension consists of three items with factor loading ranging from 0.86 to 0.47. One item had a loading below 0.40 and was deleted from consideration. An airline scoring high on this factor tends to believe in the importance of relative cost competitiveness, by keeping costs in check and research the competitors' actions.

Table 4
Factor Results for Critical Performance Factors (CPF)

Determinant factors	Component Items	Component Mean	Component SD	Eigenv.	Loading	Expl. Var.
Service strategy				7.613		22.392
Alpha = .8550	Frequent flyer programs	5.25882	3.40921		.770	
	Business passengers	6.89412	3.17739		.751	
	Yield management system	7.01190	2.77958		.637	
	Hub and spoke operations	5.06129	3.48176		.464	
	Feeder airline agreements	4.41667	3.16682		.458	
Route strategy				3.763		11.066
Alpha = .6665	Matching of aircraft size with route requirement	7.38095	2.46357		.875	
	Interlining agreements	5.76471	2.94249		.586	
	Acquisition of airport slots (Commission overrides)	6.36471	3.38360		.417	
Cost competitiveness				2.363		6.950
Alpha = .6922	Increase margins*	8.23529	1.79050		.859	
	Cost control	8.84706	1.41847		.615	
	Competitor analysis (Market-intelligent information- and communication system)	6.74118	2.16109		.473	
Performance incentives				1.948		5.729
Alpha = .8157	Employees' incentive program	5.51765	2.81836		.762	
	Managers' incentive program (Management teams)	5.85714	2.88734		.757	
Cycle-fleet-debt awaren.				1.918		5.641
Alpha = .6594	Debt reduction*	6.11111	3.07834		.876	
	Acquisition of new aircraft	7.12941	2.77226		.502	
	Forecasting adverse effects of the economy on the airline	6.42000	2.14593		.475	
	Fuel costs	7.05952	2.16768		.432	
Information systems				1.725		5.074
Alpha = .7072	Logistics systems	6.42169	2.20994		.715	
	Control systems	6.88095	1.97246		.534	
	Inter departmental communication	6.55294	1.98510		.414	
Labour flexibility				1.390		4.088
Alpha = .6191	Flexible job descriptions*	6.38824	2.46931		.884	
	Job rotation*	4.04788	2.31694		.551	
Market demand				1.237		3.640
Alpha = .5439	Media advertising	6.20238	2.29793		.902	
	Market research	6.36905	2.15903		.471	
	Price leadership in served markets (Expansion into new markets)	6.86747	2.73762		.433	
Financial restructuring				1.142		3.359
Alpha = .6178	Cost reduction	8.14118	1.94050		.756	
	Reduction of labor costs	6.69048	2.76016		.654	
External growth				1.025		3.015
Alpha = .5462	Merger acquisition to gain market share	3.11271	2.97227		.631	

Alliance with the incumbents*	5.34212	3.04764	.522
Diversification into other industries	1.50094	2.21154	.412

* Significantly different between 93 and 98 Surveys.

The fourth factor was labeled *performance incentives* (α = .82) and explained 5.7% of the total variation. This dimension consisted of two items with approximately the same factor loading of 0.76. One item had a loading below 0.40 and was deleted from consideration. An airline who scores high on this factor will emphasize incentive programs as a tool to motivate employees. The fifth factor labeled *cycle-fleet-debt awareness* '(α = .66) explained 5.6% of the variation. This dimension consisted of four items with loading ranging from 0.88 to 0.43. An airline which scores high on this factor tends to have high awareness of the impact of economic cycles and debt in the fleet acquisition process. The sixth factor labeled *information systems* ' (α = .71) explained 5.1% of the total variation. It consists of three items with loading ranging from 0.72 to 0.41. An airline that scores high on this factor tends to believe in the importance of organizational integration as well as control through information systems.

The seventh factor labeled *labor flexibility* '(α = .62) explained 4.1% of the total variation. It consists of two items with loading of 0.88 and 0.55. An airline that scores high on this factor tends to believe in the importance of flexible workforce and job rotation to motivate employees and achieve responsiveness to customers' needs, e.g. service quality. The eight factor labeled *market demand* '(α =.54) explained 3.6% of the total variation. The factor consists of three items with loading ranging from 0.90 to 0.43. One item had a loading below 0.40 and was deleted from consideration. An airline scoring high on this factor places high importance on stimulating demand though advertising and price leadership that is well grounded through market research. The ninth factor labeled *financial restructuring* '(α = .62) explained 3.4% of the total variation. Two items loaded on this factor with loading of 0.76 and 0.65. Airlines scoring high on this factor are in the process of reducing costs opposed to keeping costs in check, as a result high ranking implies restructuring. The tenth factor labeled as *external growth* '(α = .55) explained 3.0% of the total variation. This factor consists of three items with loading ranging from 0.63 to 0.41. Airlines scoring high on this factor tend to seek growth through external means such as mergers and alliances.

The second level exploratory factor analysis (*see* Table 5) was rooted in the *Performance Indicator* and *External Influence* analogy and as such is constructed from observed items that can normally not be directly manipulated by airline managers.

Table 5

Factor Results for Performance Indicators and External Influence (PI/EI)

Determinant factors	Component Items	Component Mean	Component SD	Eigenv.	Loading	Expl. Var.
Productivity				5.713		28.563
Alpha = .7830	Employees' productivity	8.23529	1.72273		.730	
	Shared company vision	6.65882	2.58914		.687	
	Company culture	7.51765	2.02138		.674	
	Aircraft utilization	8.53571	1.40955		.523	
	Service quality	8.12941	1.85670		.517	
	Long-term rather than short-term profits*	6.17647	2.74372		.404	
Brand image				2.209		11.046
Alpha = .6659	Brand image	7.70024	2.18913		.732	
	Favorable attitude of travel agents (Quality of terminal space and ground facilities)	7.30588	2.38559		.602	
Empowerment				1.504		7.521
Alpha = .6903	Employees' autonomy to take decisions	6.52381	1.69366		.692	
	Decentralized organization structure	4.80952	2.68805		.601	
	Delegation	6.60494	1.88780		.544	
External constraints				1.380		6.898
Alpha = .6372	Management's external contacts	6.32941	2.24875		.803	
	Influencing government policy on aviation	6.45238	2.56071		.531	
Market power				1.215		6.077
Alpha = .5213	Market share	5.90588	2.67983		.940	

	Achieving critical mass	5.67071	2.97675		.432	
	Investors' attitudes towards the airline	7.02381	2.72107		.418	
Distribution effectiveness				1.002		5.009
Alpha = .5620	Computer reservation systems	7.25882	2.61020		.874	
	Passenger load factors	7.57647	2.07236		.413	

* Significantly different between 93 and 98 Surveys.

The first factor labeled *productivity* '(α = .78) 28.6% of the total variation. This factor consists of six items with loading ranging from 0.73 to 0.40. Airlines scoring high on this factor tend to believe that high productivity, quality and long-term profitability is achieved through shared employee beliefs, reflected in vision and culture. The second factor labeled *brand image* '(α = .67) explained 11.0% of the total variation. This factor consists of two items with loading of 0.73 and 0.60. One item had a loading below 0.40 and was deleted from consideration. Airlines scoring high on this factor tend to emphasize brand image, believing in its importance in the distribution network in terms of favorable attitude of travel agents. The third factor labeled *empowerment* ' (α = .69) explained 7.5% of the total variation. It consists of three items with loading ranging from 0.69 to 0.54. Airlines scoring high on this factor tend to believe in employee's autonomy and the practice of delegation. The fourth factor labeled *external constraints* '(α = .64) explained 6.9% of the total variation. The factor consists of two items with loading of 0.80 and 0.53. Airlines scoring high on this factor tend to believe in the importance of facilitating the airline's wellbeing through external influence. The fifth factor labeled *market power* '(α = .52) explained 6.1% of the total variation. It consists of three items with loading ranging from 0.94 to 0.42. Airlines scoring high on this factor tend to believe in the importance of size in order to attract investment in the airline. The seventh factor *distribution effectiveness* '(α = .56) explained 5.0% of the total variation. The factor consists of two items with loading of 0.87 and 0.41. Airlines scoring high on this factor tend to believe in the importance of computers reservation systems to boost passenger load factors.

RESULTS OF CORRELATION AND MULTIPLE LINEAR REGRESSION ANALYSIS

Hypothesis

A number of hypothesis were formulated based on literature review and case studies in order to predict relationships between the factors, identified across the two levels: CPF and CI/EI.

The second level factor productivity is assumed to represent how airlines believe that high productivity, quality and long-term profitability is achieved through shared employees' beliefs, reflected in vision and culture. As a result, it is assumed that the factor is related to first level factors that have positive impact on employees' productivity, while factors such as financial restructuring will either have negative or non-significant relation with productivity. This stems from the assumption that employee reduction or other forms of cost reduction will create tensions (Doherty and Horsted, 1996) associated with reduced productivity in the respondents' mind, this assumption is made regardless of whether such negative productivity impact occurs or not. What is clear, however, is that cost reductions and employee redundancies will most likely affect the business culture and vision in an adverse way in the short-term.

> H_1: Productivity will be significantly related to service strategy, route strategy, performance incentives, information systems and labor flexibility.

The factor brand image is assumed to represent airlines that believe in the importance of the brand to penetrate the distribution network in terms of favorable attitude of travel agents (TA). An important fact here is that an estimated 41% of business travelers and 55% of leisure travelers leave carrier choice to their TAs, while 51% of TAs selected the carrier they had commission override with (Travel Agency Market Survey, 1987). Brand image as such has to

work as selection advantage in a case of two similar choices, not only with the TA but also the passenger depending on who exercises the decision power. The creation of brand image in the minds of these two groups is probably somewhat different although no studies exist to support that assumption. As a result, it is expected that the factor is significantly related to service strategy because service is an important function of brand image. Another service element is route strategy providing for as close a match as possible with what the TA expects, e.g. good connections (function of interlining agreements), convenient departure times (function of airport slots) and frequency (function of matching aircraft size with route requirement). The last item can imply two things: i) that more frequency with smaller equipment is more favorable especially in terms of business passengers; ii) that the airline should be competent in adjusting aircraft size with demand to reduce the probability of passenger diversion from specific flights (involves more time spent on behalf of the TA finding a flight). Brand image is also expected to be related to labor flexibility, as positive staff willing to walk that extra mile for the benefit of the passenger has a strong impression on the customer (Airline Executive, 1990). This is what Carlson (1987) termed as turning the organizational pyramid upside down, empowering the front-line staff to take unprecedented decisions for the customers' benefit at their specific level. Further, if the concept is expanded one can assume that flexible job descriptions increase the responsiveness of the organization a potentially important element in facilitating brand image and proactive service provision. Finally, market demand is expected to be related to brand image. The factor market demand is composed of items dealing with advertising and market research, both of which shape the ability of the airline to build its brand image. In the past new-entrant carriers, with PeoplExpress being the prime example, have had brand image conflicts due to changes in strategy, such as no-frills to frills, projected to the market through advertising (Davidow and Uttal, 1989). Based on past case histories (Gudmundsson, 1998) new-entrants should be aware of the impact of service strategy on brand image in the long-term.

> H_2: Brand image will be significantly related with service strategy, route strategy, labor flexibility and market demand.

Airlines scoring high on the factor empowerment tend to believe in employee's autonomy (Thomas & Velthouse, 1990) and the practice of delegation to achieve higher performance. As such the factor is expected to be significantly related with labor flexibility. Labor flexibility increases the necessity to cooperate, just as job rotation as a function of empowerment introduces to the employee different functions and stimulates proactive (Spreitzer, 1995) behavior and cross-departmental knowledge. Labor flexibility as an element of empowerment is also a crucial cost saving tool, by cross-training staff to perform various functions and make decisions. As a result, empowerment is expected to be significantly related cost competitiveness.

> H_3: Empowerment will be significantly related to labor flexibility and cost competitiveness.

Airlines scoring high on external constraints tend to believe in the importance of facilitating the airline's well-being through external influence. Policy making in air transport is high on the agenda in most countries, although, one can assume that the nature of airlines' influence on governments and agencies has changed in liberalized and deregulated markets. For new-entrants, opposed to large incumbents, we can expect some variation in interest, with two issues high on the agenda being CRS biases (Beuvais, 1993) and lack of slots (Morrell, 1998). As a result, it is expected that route strategy will be significantly related to external constraints. Furthermore, external constraints influence costs and governmental influence, federal or local, is often necessary when entering or protecting markets. As a result, external constraints are expected to be positively related with cost competitiveness.

> H_4: External constraints will be significantly related to route strategy and cost competitiveness.

It was assumed that airlines scoring high on market power tend to believe in the importance of size in order to attract investment in the airline. As a result, it is expected that factors dealing with the network, competitiveness, routes, growth, integration and reputation in the financial community to be important. The following factors are expected to have significant relationship with market power: service strategy, route strategy, cost competitiveness, information systems, market demand, financial restructuring and external growth. Service strategy includes items such as hub and spoke networks that are important to create scale (Bania, Bauer and Zlatoper, 1998) usually assumed necessary to achieve market power. Route strategy includes items such as acquisition of slots that is necessary to achieve market-share. Cost competitiveness is a vehicle towards market power, allowing the airline to offer competitive prices in order to build market share. The PIMS (Buzzel & Gale, 1987) program identified low prices without cost competitiveness and quality as an vehicle towards market share as being non-sustainable strategy. Information systems are necessary to keep the organization integrated, especially if it grows fast, which is a characteristic of market-share driven businesses. Market demand is the vehicle towards market power, composed of advertising, market research and price leadership. Financial restructuring such as cost reduction and labor cost reduction especially is important to show firm control (Flint, 1999) in the business, in turn creating favorable image within the financial community that provides capital necessary expansion programs to reach critical mass and market share. External growth is the final factor expected to be related to market power. This factor was not emphasized highly by most respondents as can be seen from the item averages. However, alliances is most prominent and especially important for an airline wishing to achieve critical mass quickly.

> H_5: Market power will be significantly related to service strategy, route strategy, cost competitiveness, information systems, market demand, financial restructuring and external growth.

Airlines scoring high on distribution effectiveness tend to believe in the importance of computers reservation systems to boost passenger load factors. For new-entrants the attitude on this factor should be diverse as some do not participate in CRSs, while those that do have strong views on a partial stand of the CRS owner airlines (Feldman, 1997). It is expected that this factor is significantly related to service strategy, route strategy and market demand. Computer reservation systems are important to communicate information about products, e.g. distribute the product. Service strategy creates the right product that is pushed through the distribution systems and affects load utilization. Route strategy provides is composed of items pertaining to capacity, connections, and convenient departure times and routes through availability of slots. As all of these items are communicated through the CRS as an distribution element (product) it is expected that route strategy is significantly related to distribution effectiveness. The final factor expected to be significantly related with distribution effectiveness is market demand. Advertising, market research and price leadership that compose the factor, are items that are communicated through the CRS and impact loads.

> H_6: Distribution effectiveness will be significantly related service strategy, route strategy and market demand.

The testing of the hypotheses will be conducted through correlation analysis across the two levels CPF and PI/EI and then followed by multiple linear regression analysis to explore further the strengths of the relationships and the fit to the hypotheses established in this section.

Correlation analysis

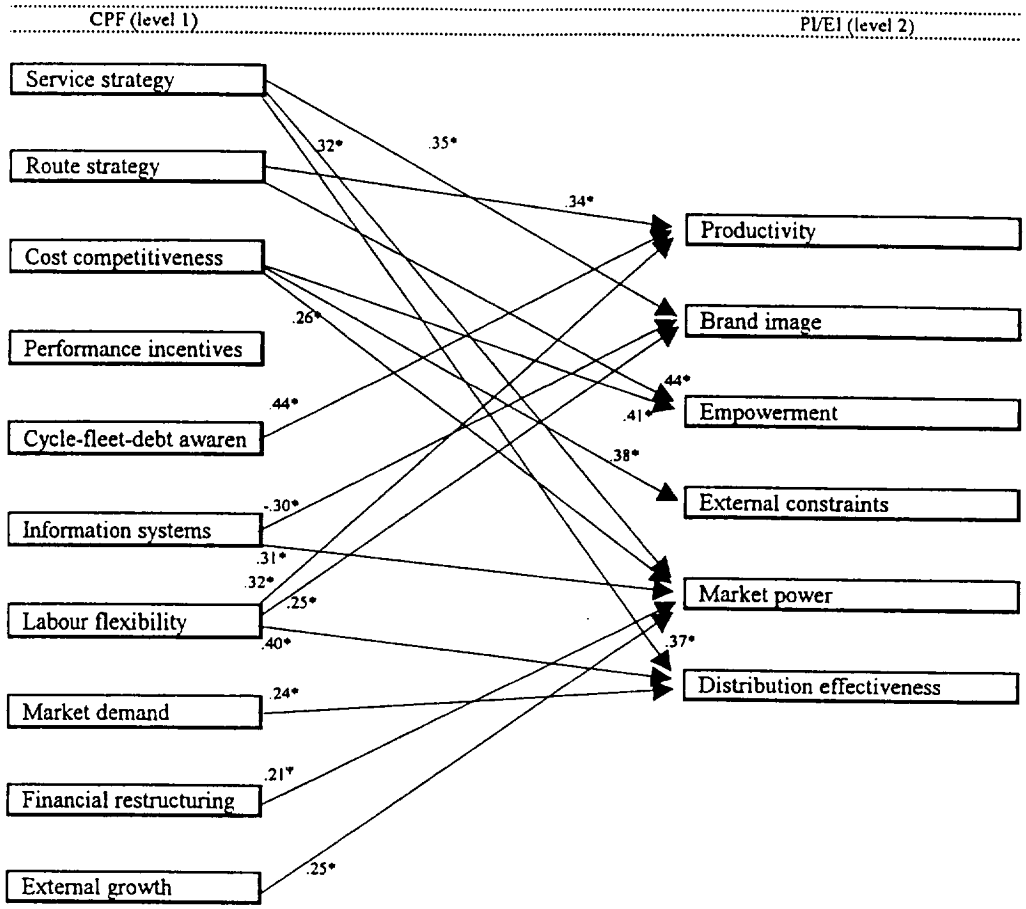
Correlation analysis (*see* Figure 4 and Table 6) revealed that the second level factor *productivity* was significantly correlated with service strategy (r = -.21, p < .05) route strategy (r = .34, p < .01), cycle-fleet-debt awareness (r = .44, p < .01) and labor flexibility (r = .32, p < .01). *Brand image* was significantly related service strategy (r = .35, p < .01), information systems (r = -.30, p < .05) and labor flexibility (r = .25, p < .05).

Empowerment was significantly related with route strategy (r = .44, p < .01) and cost competitiveness (r = .41, p < .01). *External constraints* was significantly related only with cost competitiveness (r = .38, p < .01). *Market power* was significantly related with service strategy (r = .32, p < .05), cost competitiveness (r = .26, p < .05), information systems (r = .31, p < .05), external growth (r = .25, p < .05) and weak significance with financial restructuring (r = .21, p < .1). *Distribution effectiveness* had significant correlation with service strategy (r = .37, p < .01), labor flexibility (r = .40, p < .01) and market demand (r = .24, p < .05).

Table 6
Factor Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Productivity	1.000															
2. Brand image	.064	1.000														
3. Empowerment	.134	.084	1.000													
4. External constraints	.061	-.027	.044	1.000												
5. Market power	-.027	.052	-.019	.066	1.000											
6. Distribution effectiveness	-.002	.144	-.025	-.010	-.045	1.000										
7. Service strategy	-.207	.351	-.103	-.030	.322	.369	1.000									
8. Route strategy	.335	.071	.436	.060	.133	.020	-.013	1.000								
9. Cost competitiveness	.144	.133	.409	.384	.264	-.001	.012	.013	1.000							
10. Performance incentives	.123	.187	.051	-.141	.118	.079	-.032	.013	-.002	1.000						
11. Cycle-fleet-debt awaren.	.442	-.066	-.144	-.092	-.070	.017	-.035	-.057	-.023	.006	1.000					
12. Information systems	.068	-.302	-.129	.172	.311	-.108	-.004	.014	.005	.010	.029	1.000				
13. Labour flexibility	.322	.246	.004	.108	.014	.400	.020	-.016	.027	.006	.036	-.012	1.000			
14. Market demand	.180	.081	-.092	.034	-.084	.236	.033	.005	-.037	.005	-.007	.015	.016	1.000		
15. Financial restructuring	.037	-.096	-.016	.115	.208	-.030	.051	.049	-.018	-.010	.040	.008	.020	-.026	1.000	
16. External growth	.028	.027	-.100	.095	.253	-.060	.051	-.001	-.006	-.020	.032	.039	-.053	-.031	-.031	1.000

Figure 4
Factor Correlations



** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Ψ Correlation is significant at the 0.1 level (2-tailed).

Results of Multiple Linear Regression

Stepwise approach was used for variable entry in the Multiple Linear regression (MLR) analysis. Collinearity was examined through tolerance and VIF analysis and no factor posed problems in the analysis. The MLR models explanation power of the dependent variables ranged from 7 to 49 percent.

The outcomes of productivity. The results of the stepwise MLR analysis supported Hypothesis 1 and the factors in the model explained 49 percent of the variation in the depended variable. The results showed that productivity was significantly related to route strategy ($\beta = .33$, $p < .001$), labor flexibility ($\beta = .29$, $p < .01$) and service strategy ($\beta = -.19$, $p < .05$). Other factor that entered the model were cycle-fleet-debt awareness ($\beta = .41$, $p < .001$) and market demand ($\beta = .16$, $p < .05$). Variable contribution to the model was detected through change in R^2 (cycle-fleet-debt awareness, $\Delta R^2 = .195$, $p < .001$; route strategy, $\Delta R^2 = .130$, $p < .001$; labor flexibility, $\Delta R^2 = .097$, $p < .01$; service strategy, $\Delta R^2 = .037$, $p < .05$; market demand, $\Delta R^2 = .033$, $p < .05$). Hypotheses 1 is supported, but two factors performance incentives and information systems did not enter the model, while two other factors did: cycle-fleet-debt awareness and market demand.

The outcomes of brand image. The results of the MLR analysis partially supported Hypothesis 2 and the factors in the model explained 31 percent of the variation in the depended variable. The results showed that brand image was significantly related to service strategy (β =

.32, $p < .01$) and labor flexibility ($\beta = .21$, $p < .05$). However, two other factors contributed to the explained variation in brand image, namely information systems ($\beta = -.26$, $p < .01$) and performance incentives ($\beta = .17$, $p < .1$). The change in R^2 was examined to detect each factors contribution to the explained variation in R^2 (service strategy, $\Delta R^2 = .124$, $p < .01$; information systems, $\Delta R^2 = .090$, $p < .01$; labor flexibility, $\Delta R^2 = .055$, $p < .05$; performance incentives, $\Delta R^2 = .040$, $p < .1$). Hypothesis 2 is supported by two expected factors but two factors did not enter the model, route strategy and market demand, while two theoretically unexpected factors entered, information systems and performance incentives.

The outcomes of empowerment. The results of the MLR analysis partially supported Hypotheses 3 and the factors in the model explained 35 percent of the variation in the depended variable. The results showed that empowerment was significantly related to route strategy ($\beta = .35$, $p < .001$) and cost competitiveness ($\beta = .33$, $p < .001$). The change in R^2 was examined to detect each factors contribution to the explained variation in R^2 (route strategy, $\Delta R^2 = .19$, $p < .001$; cost competitiveness, $\Delta R^2 = .16$, $p < .01$). The model supports Hypotheses 3 in terms of factor cost competitiveness entering the model. However, an theoretically unexpected factor route strategy entered instead of the expected labor flexibility.

The outcomes of external constraints. The results of the stepwise MLR analysis supported Hypotheses 4 and the factors in the model explained 15 percent of the variation in the depended variable. The results showed that external constraints was significantly related to cost competitiveness ($\beta = .31$, $p < .01$). No other factors entered the model.

Table 7
Results of Multiple Regression Analysis

	ΔR^2	β	SE	Beta	*t*	*Sig.*
I. Dependent Variable: Productivity						
Cycle-fleet-debt awareness	.195	.409	.080	.446	5.146	.000
Route strategy	.130	.333	.080	.361	4.175	.000
Labour flexibility	.097	.288	.080	.313	3.620	.001
Service strategy	.037	-.185	.081	-.198	-2.288	.025
Market demand	.033	.164	.078	.182	2.105	.039
R^2	.492	Adj. R^2	.455	F = 13.187	*Sig.*	.000
II. Dependent Variable: Brand image						
Service strategy	.124	.319	.090	.354	3.536	.001
Information systems	.090	-.262	.087	-.299	-2.989	.004
Labour flexibility	.055	.208	.089	.234	2.340	.022
Performance incentives	.040	.173	.087	.200	1.997	.050
R^2	.310	Adj. R^2	.270	F = 7.737	*Sig.*	.000
III. Dependent Variable: Empowerment						
Route strategy	.190	.351	.078	.430	4.507	.000
Cost competitiveness	.163	.327	.077	.403	4.225	.000
R^2	.353	Adj. R^2	.334	F = 19.330	*Sig.*	.000
IV. Dependent Variable: External constraints						
Cost competitiveness		.314	.089	.383	3.522	.001
R^2	.147	Adj. R^2	.135	F = 12.404	*Sig.*	.001
V. Dependent Variable: Market power						
Service strategy	.103	.298	.097	.298	3.061	.003
Information systems	.097	.292	.094	.300	3.093	.003
Cost competitiveness	.067	.258	.095	.264	2.720	.008
External growth	.052	.240	.099	.235	2.415	.018
Financial restructuring	.041	.197	.094	.202	2.083	.041
R^2	.360	Adj. R^2	.313	F = 7.651	*Sig.*	.000
VI. Dependent Variable: Distribution effectiveness						
Labour flexibility	.159	.373	.094	.388	3.984	.000
Service strategy	.128	.343	.095	.351	3.604	.001
Market demand	.048	.207	.092	.220	2.254	.027
R^2	.336	Adj. R^2	.307	F = 11.790	*Sig.*	.000

The outcomes of market power. The results of the MLR analysis supported Hypotheses 5 and the factors in the model explained 36 percent of the variation in the depended variable. The results showed that market power is significantly related to service strategy (β = .30, p < .01), information systems (β = .29, p < .01), cost competitiveness (β = .26, p < .01), external growth (β = .24, p < .05) and financial restructuring (β = .20, p < .05). Variable contribution to the model was detected through change in R^2 (service strategy, ΔR^2 = .103, p < .01; information systems, ΔR^2 = .097, p < .01; cost competitiveness, ΔR^2 = .067, p < .05; external growth, ΔR^2 = .052, p < .05; financial restructuring, ΔR^2 = .041, p < .05). All factors entering the model were expected, but two additional factors expected did not enter, route strategy and market demand.

The outcomes of distribution effectiveness. The results of the stepwise MLR analysis supported Hypotheses 7 and the factors in the model explained 34 percent of the variation in the depended variable. The results showed that distribution effectiveness was significantly related labor flexibility (β = .37, p < .001), service strategy (β = .34, p < .01) and market demand (β = .21, p < .05). Variable contribution to the model was detected through change in R^2 (labor flexibility, ΔR^2 = .159, p < .001; service strategy, ΔR^2 = .128, p < .01; market demand, ΔR^2 = .048, p < .05). Hypotheses 7 is supported but an unexpected variable entered the model, labor flexibility instead of the expected route strategy.

DISCUSSION

Practical implications

The major findings are that a PI factor labeled productivity has the strongest relationship with CPF factors labeled cycle-fleet-debt awareness, route strategy, labor flexibility, service strategy and market demand. The first factor cycle-fleet-debt awareness that explains comparatively most of the variation in productivity, can be related to its proactive nature of preparing for industry downturn in order to preserve the overall airline productivity. The second factor route strategy deals the matching of resources with requirements and binding together the various components of a route to provide optimum service given the resources available. As such, it is quite logical that route strategy has positive relationship with productivity. Labor flexibility is another clearly related factor, as has been demonstrated by so many new-entrant airlines, such as PeoplExpress that were able to achieve lower costs through greater staff flexibility. Service strategy had a negative relation with productivity. After close examination, this is not an unexpected finding, as service strategy is composed of items related to business passengers that require more service in terms of time, expensive service features such as empty middle seat, reducing the overall perceived productivity although the revenue implications might be positive. The last factor market demand deals with the generation of demand through advertising but also research and price leadership. As such it has spill-over effect on how the employees view the airline they work for - a well researched marketing campaign reinforces the employees sense of purpose. What is more such campaign is essential to generate demand to maintain utilization of resources, especially at the outset of opening new routes.

There were four factors that were related to brand image: service strategy, information systems, labor flexibility and performance incentives. Service strategy deals with what product the airline is offering as is, therefore, logically associated with brand image. Positive brand image has important impact on demand, whose interaction with the airline is in most cases through travel agents. The pull of brand image is therefore through systems that must be well integrated to reinforce the image created through an effective service strategy. Labor flexibility is crucial for creating a good impression while experiencing a brand that has viewed highly before use. Flexibility allows the employees to react quickly and effectively to acute situations, creating a good impression with the passenger, e.g. employees ability to react to special situations will either reinforce or destroy a good brand image during the consumption stage. This is a well documented de facto in services marketing. Performance incentives was the last factor contributing to the variation in brand image. Here again the expected relationship is the motivation of employees to provide good impression in the process of their jobs - to walk that extra mile to make a difference.

Two factors contributed to the explanation of the variation in empowerment: route strategy and cost competitiveness. Route strategy does not have an obvious theoretical relationship with empowerment. However, cost competitiveness has as it is expected that empowernent will have positive impact on the airline's effectiveness and flexibility.

External constraints was related with one factor, cost competitiveness. Here it seems that management's external contacts and ability to influence government policy can have cost implications for the airline. It was expected that there would be difference between European and US carriers on the items composing factor external constraints, but a *t* test showed a non-significant difference between the two groups. As such the factor must, therefore, be viewed as having communality between both groups and constitute an element in achieving cost competitiveness.

Five factors contributed to the variation in market power: service strategy, information systems, cost competitiveness, external growth and financial restructuring. Market power represents the emphasis the airline levies on size and investor's attitudes towards the airlines. The investors, of course, playing a crucial role in raising capital necessary for market-share building and the resulting critical mass. The vehicle towards sustainable market power has to be service strategy, which attracts business passengers, keeps them loyal (frequent flyer programs), captures customers through economies of density and scope (hub and spoke) and provides maximum yields through a yield management system, in the face of potentially fierce competition. Information systems become increasingly important as the organization grows. Thus, it is not surprising to see a relationship between market power (size emphasis) and information systems (organizational integration). Cost competitiveness is another important vehicle towards market power as it is unlikely that the airline will reach size without cost competitiveness. This is more relevant ot new-entrant airlines as such airlines emerge from size disadvantage (subject to the market power of incumbents) and must as a consequence achieve substantial advantage on this factor. External growth is an external means to an end. Where the airline emphasizes quick expansion through alliances and mergers. Diversification into other industries one of the items in the sub-scale was not emphasized much by any of the airlines but showed nevertheless correlation with the underlying factor. Financial restructuring was the fifth and final factor that was found to be related with the factor market power. Here it is assumed that financial restructuring is an vehicle towards positive image in the financial community to maintain capital influx for further expansion and increased staying power during industry recession.

Three factors contributed to the explanation of the variation in distribution effectiveness: labor flexibility, service strategy and market demand. An obvious theoretical explanation for the explanatory power of labor flexibility to distribution effectiveness was not found. However, service strategy is an important element in the distribution system as such. This stems from the fact that distribution system presence is not enough, there has to be a sellable product in order for travel agents to search the CRS and sell the airline. The third and last item market demand is obviously related as it deals with targeted advertising of the airline's products, with most of the selling going through the TA's and the CRS.

Limitations

The results should be viewed in the light of the data's limitations. The population of new-entrant airlines is small, necessitating a longitudinal approach to boost the number of cases. To validate the scales with higher degree of certainty still more cases are needed, although, this study almost reached the recommended (Spector, 1992) minimum of 100 cases.

The longitudinal approach necessitates high degree of concurrence between responses over a period of time. The study showed that similarity in rating strengths is de facto for the two studies as few items showed statistical difference of the means, implying an important trait in the constructs. For the items showing significant difference the explanation appears to be that the former study was done during an industry recession and the second during an industry up-turn. As a result, items associated with the financial aspects of airline management were basically the only ones showing a significant difference between the two studies.

Findings of previous research are sometimes related to the symptoms that result from the application of management tools. Thus, one must make it clear that managers should not attempt to forge changes in the symptomatic indicators but emphasize changes in the actual tools

according to concrete analysis as to the impact that such change will have on the organization. The research presented here attempted to link together the tools and the indicators. Although the instrument administered to the airline managers may still need improvement it is important as an initial step to identify useful constructs and underlying factors that can provide for a standard qualitative scale measuring airline management. What is important to note is that the scale takes external approach in order to make the association of actual variation in strength applied to the items easier to associate with the airline's performance. This approach was taken to reduce the impact of 'social desirability' (Crowne and Marlowe, 1964) on the rating strength, e.g. ratings according to what is generally accepted in the industry or to make one look good externally.

The factor analytical approach identified a number of sub-scales that showed good internal consistency among items and therefore worthwhile to research further in a wider context, such as among managers of other airline populations. Furthermore, the relationship among factors at the two levels showed interesting trends that need further confirmation. However, it must also be made clear that, as with all factor analytical, studies there may be a number of different factors possible based on the data. What is more the elimination of one item from the analysis can substantially change the final outcome of the analysis. This fact does, however, not undermine the value of factor analytical study as a factor that is proved to be stable in separate studies and measure what it allegedly is supposed to measure is valuable to researchers.

Conclusion

In this study the first steps have been taken in creating scales according to a concept of multiple levels of qualitative factors explaining airline management performance. A number of constructs have been suggested that will need further research. It is hoped that this attempt at creating constructs for qualitative research into airline management will spark interest in validation and further research into qualitative measurement instruments in airline research. The results of this study support the viability of the concept of CPF and PI for qualitative research.

The relatively simple framework presented in the paper on distinguishing between causal factors, performance indicators and environment influence, should be considered by researchers and practitioners wishing to research and understand the qualitative factors related to airline management.

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STRATEGIC ALLIANCE AND FIRM VALUE: A LONGITUDINAL STUDY OF THE BRITISH AIRWAYS/USAIR ALLIANCE

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STRATEGIC ALLIANCE AND FIRM VALUE: A LONGITUDINAL STUDY OF THE BRITISH AIRWAYS/USAIR ALLIANCE

ABSTRACT

This study examines the effects of an international alliance on the value of partner firms as well as their rival firms. We find that over a series of events leading to the British Airways/USAir alliance, partner firms' abnormal returns respond positively to "promising" events that increase the likelihood of that alliance, whereas they respond negatively to "discouraging" events that decrease the likelihood. In contrast, rival firms' abnormal returns decrease following promising events while they increase following discouraging events. Our further analysis, however, does not reveal evidence for degree of rivalry with partner firms as a moderator in explaining the effects on rival firms' value. Our findings suggest that international alliances appear to strengthen partner firms' competitive positions which in turn threatens the competitive positions of rival firms, thus decreasing the rivals' value.

Key words: International alliances; Partner firms' value; Rival firms' value.

INTRODUCTION

The recent dramatic increase of alliances has led scholars to investigate the causes and consequences of inter-organizational alliances, establishing two research streams. One stream examines the procedural issues of alliance formation such as motivation of alliance, partner selection, governance structure, and evolution of alliance (e.g., Burgers, Hill, & Kim, 1993; Hamel, 1991; Inkpen, 1995; Parkhe, 1991). The other investigates the consequences of alliance itself such as alliance duration, stability, and longevity, and its influence on the performance of firms entering alliances (e.g., Dussauge & Garrette, 1995; Geringer & Herbert, 1989). Unlike the procedural issues of alliance heavily examined by conceptual and empirical research, the aspects of alliance consequences have received relatively less attention from scholars. In particular, the question of whether alliance formation increases or decreases the value of participating firms has been scarcely tested. A few empirical efforts (Chan, Kensinger, Keown, & Martin, 1997; Das, Sen, & Sengupta, 1998) studied changes in partner firms' stock prices when the partners announced new alliances. Yet the consequences of alliance formation on rival firms rather than partner firms, with a few exceptions (Singh & Mitchell, 1996), have been neglected in the alliance literature. In the international context, the question of whether international alliance formation affects rival firms' as well as partner firms' value has been even hardly tested by empirical as well as conceptual works.

This study aims to expand the alliance literature into the effects of alliance announcements on the value of partner firms as well as their rival firms in the international setting. A firm's strategic position in an industry may be jeopardized by the alliances established by its competitors since the competitors take advantage of economies of scale or scope by pooling similar facilities or combining complementary assets (Hamel, Doz, Prahalad, 1989; Kogut, 1988). In particular, international alliances may be more influential as

compared to domestic alliances. International alliances enable domestic firms to access foreign partners' strategic resources with which they build up new competitive advantages (Shan, 1990). International alliances also change competitive environments because they bring new foreign competitors into domestic markets who often add a great deal of diversity to the markets (Porter, 1980).

This study also expands the extant event studies on alliance formation into the longitudinal setting. A longitudinal approach is desirable to examine stock price changes when firms release a series of promising and discouraging announcements about their future alliances. Previous studies used cross-sectional approaches by focusing on stock market reactions to *the final announcements* of alliance formation (Chan *et al.*, 1997; Das *et al.*, 1998). Yet, when there are prior announcements about a future alliance, the contents of those announcements may affect investors' evaluation on the likelihood of that alliance. In contrast with promising announcements that favorably affect partner firms' value, discouraging ones may reveal negative influences on their value. Consequently, stock market reactions to the final announcement may be diluted by the previous announcements. Hence, the cross-sectional method relying on only the final announcement is problematic in such cases.

We focus on a particular alliance rather than developing a sample of many international alliances due to the following reasons. The requirement of our research design, international alliances should have a series of announcements that ideally include both promising and discouraging contents, strictly constrains the available sample size for our study. The requirement further complicates how to aggregate different international alliances with varying numbers and series of events into a sample. Varying series of events for each alliance affect investors' assessments on the likelihood of an alliance being consummated at different levels. Further, a large-sample approach creates empirical issues that are difficult to

manage. It appears vague to distinguish between partner and rival firms and is hard to control for interaction among alliance formation when a large number of firms are involved in the formation processes of multiple alliances. Thus, we choose an international alliance between British Airways (BA) and USAir as the research setting for this study. First, the alliance created nine different announcements over nearly eight months, five of them promising and four discouraging. This allows us to conduct a longitudinal study that examines how a series of announcements affect the value of partner firms as well as their rivals. Second, the stock-market data for both partner and rival firms are available for the period of the alliance formation. Further, partner and rival firms were listed in the same stock market during the alliance formation period, which allows us to control for market-specific factors.

In this study, we define international alliances as voluntary and continuous arrangements between firms from different countries that involve exchange, sharing, or co-development of products, technologies, or services (Gomes-Casseres, 1996; Harrigan, 1988). Partner firms refer to firms entering an international alliance whereas rival firms to firms outside that alliance and competing against the partner firms. A promising (a discouraging) event refers to the announcement that increases (decreases) the likelihood of an alliance being consummated. Based on such a premise that firms entering an alliance expect its potential benefits to be greater than its potential costs, we propose that abnormal returns to partner firms increase (decrease) following promising (discouraging) events. By contrast, we propose the opposite relationship between event types and abnormal returns to rival firms, since partner firms may harm the rivals' competitive positions through entering an alliance. Further, we propose that degree of rivalry with partner firms affects abnormal returns to rival firms. Specifically, we expect that promising (discouraging) events decrease (increase) the abnormal returns of closer rivals more significantly than those of less close ones.

We find that over a series of announcements leading to the BA/USAir alliance, promising events increase abnormal returns for partner firms while they decrease abnormal returns for rival firms. Concurrently, discouraging events decrease abnormal returns for partner firms while they increase abnormal returns for rival firms. However, our findings provide no significant evidence for degree of rivalry with partner firms as a moderator in explaining the effects of alliance announcements on rival firms' value. Instead, firm size appears to be a better moderator for the effects on rival firms' value. The value of smaller rival firms is more sensitive than that of larger rivals to both promising and discouraging events. Overall, our results suggest that international alliances appear to strengthen partner firms' competitive positions which in turn weakens rival firms' competitive positions, decreasing the rivals' value.

INTERNATIONAL ALLIANCE IMPACTS ON PARTNER AND RIVAL FIRMS

Value of Partner Firms

A substantial literature concerning alliance impacts on firm performance has identified a range of benefits from alliances. The benefits include cost- and risk-sharing, access to markets, obtaining required capital and complementary assets, improved capacity for rapid learning, knowledge transfer, sales increase, and external legitimacy (Arora & Gambardella, 1990; Baum & Oliver, 1992; Contractor & Lorange, 1988; Miner, Amburgey, & Stearns, 1990; Powell, Koput, & Smith-Doerr, 1996). These benefits are more important when alliances provide timely access to necessary and/or scarce resources in different countries. As such, entering alliances will help firms not only improve their operating efficiency but also strengthen their market positions (Harrigan, 1985; Kogut, 1988) which will have a positive effect on profitability (Eisenhardt & Schoonhoven, 1996).

Within the context of domestic market, a few studies analyzed the impact of alliance formation on partner firms' stock values. Koh and Venkataraman (1991) found that the announcements of joint-venture agreements led to positive abnormal returns on the participating firms' stocks. Chan *et al.* (1997) found that average abnormal returns to partner firms increased by 0.64% on the day of announcement of alliance arrangements. Das *et al.* (1998) found that announcements of technological alliances increased partner firms' abnormal returns by an average of about 1%, while those of marketing alliances did not increase partner firms' abnormal returns.

Yet alliances may also reduce partner firms' value due to the potential costs of alliances. Alliance partners may behave opportunistically because of a possible future break-up (Hamel *et al.*, 1989; Kranton, 1996). Such inherent opportunistic behavior is likely to lead to various transaction costs of searching reliable partners, designing contracts, and especially monitoring the behavior of the partners. The concept of alliances as a learning race in which each participant tries to learn as much as possible from its partner while divulging as little as possible, implies that alliance formation can reduce participating firms' value (Khanna, Gulati, & Nohria, 1998). Some studies have shown that alliances have a negative impact on partner firms' performance. Berg and Friedman (1980) found that joint ventures for knowledge acquisition had a negative impact on the rate of return. Uzzi (1997) reminded that a large number of previously linked alliances decreased firm value. An alliance may risk a firm leaking its firm-specific knowledge to its partner. As such, firms may lose control of important assets to their partner (Hamel, 1991; Hamel *et al.*, 1989; Williamson, 1991). While appropriate use of alliance governance mode ameliorates these concerns (Bleeke & Ernst, 1993; Gulati, 1995), intra-alliance rivalry between partner firms potentially disrupts an alliance and dampens partner firms' value.

However, despite the potential costs of international alliances, a firm is likely to enter alliances when it expects the potential benefits of the alliances to exceed the potential costs. Hence, for promising announcements about a future international alliance, investors expect the likelihood of the alliance being materialized to increase. As a result, this updated expectation in the stock market will increase the partner firms' stock prices. Conversely, in case of discouraging announcements, the partners' stock prices will likely decrease as a consequence of investors' downward adjustment on the perceived likelihood of alliance formation. Thus, we propose:

Proposition 1a: For a series of announcements, promising announcements will be positively associated with abnormal returns for partner firms.

Proposition 1b: For a series of announcements, discouraging announcements will be negatively associated with abnormal returns for partner firms.

Value of rival firms

International alliances are likely to reduce the value of rival firms. First of all, partner firms' alliance may jeopardize rival firms' competitive advantages. As mentioned above, international alliances enable partner firms to obtain a wide range of benefits. Accordingly, international alliances provide partner firms with varying sources of competitive advantages because it is difficult for rival firms to replicate similar alliances due to barriers to international alliances such as time, financial, and legal constraints. As such, the enhanced competitive advantages of partner firms will deteriorate rival firms' competitive positions. Singh and Mitchell (1996) found that firms were more likely to shut down if they did not form similar cooperative relationships after their partners formed an alliance with a third firm. Thus, these international alliances decrease rival firms' value.

Second, international alliances enhance partner firms' strategic position in markets because the distribution channels and buying power of the partners can be combined (Hamel

et al. 1989; Jorde & Teece, 1990; Shan, 1990; Teece, 1987). Partner firms' strategic positions also improve through new market entry and market entry deterrence (Hagedoorn, 1993; Vernon, 1983; Vickers, 1985). This improved market position leads to increases in partner firms' value (Eisenhardt & Schoonhoven, 1996) and in turn decreases in rival firms' value. Park and Cho (1997) found that international alliances decreased rival firms' market share due to the strengthened market positions of partner firms.

Furthermore, international alliances allow partner firms to communicate easily with each other due both to trust-building between partners and to their past experiences (Dyer, 1996; Gulati, 1995; Parkhe, 1993). The enhanced communication channel helps partner firms coordinate their strategic activities as well as pricing policy in markets, enabling them to charge more competitive prices than rival firms. Accordingly, the competitive positions of firms will become weaker when their rivals enter an alliance.

If investors expect that alliances increase partner firms' competitive edges which in turn decreases rival firms' competitive positions, rival firms' stock prices decrease following promising announcements of alliance formation while they increase following discouraging announcements of alliance formation. Hence, we propose:

Proposition 2a: For a series of announcements, promising announcements will be negatively associated with abnormal returns for rival firms.

Proposition 2b: For a series of announcements, discouraging announcements will be positively associated with abnormal returns for rival firms.

Degree of rivalry

Previous studies have suggested that degree of rivalry among competitors play an important role in firms' strategic reactions. Degree of rivalry among airlines varied according to their market overlaps and fleet structures, indicating that an airline did not equally compete with all other airlines (Chen, 1996). Besides, previous studies showed that a firm's strategic

actions such as alliance formation, price cuts, and promotions could prompt quicker reactions from head-to-head competitors than from other competitors (Chen & MacMillan, 1992; Miller & Chen, 1994; Smith, Grimm, Gannon, & Chen, 1991).

Propositions 1 and 2 suggest that an international alliance will likely affect competitive environments in a way that enhances the competitive positions of partner firms but deteriorates those of rival firms. We further conjecture that an alliance will likely worsen the competitive edges of closer rivals to a greater degree than those of less close ones, since the closer rivals will face relatively stiffer competition with partner firms than will the other rivals. As such, for an alliance to be consummated, the value of closer rival firms is likely to decrease at a lower level than is that of less close rivals, all other things being equal. Thus, following promising announcements of alliances, decreases in closer rival firms' value will be greater than decreases in less close rivals' value. In contrast, following discouraging announcements, closer rivals' value will increase more than increases in less close rivals' value. Hence, we propose:

Proposition 3a: For a series of announcements, promising announcements of partner firms' alliance will decrease abnormal returns of closer rival firms more than those of less close rival firms.

Proposition 3b: For a series of announcements, discouraging announcements of partner firms' alliance will increase abnormal returns of closer rival firms more than those of less close rival firms.

METHOD

Description of events

To identify a series of events leading to the BA/USAir alliance, we searched the Dow Jones News Retrieval Service database, which included *the Dow Jones News Wire*, *the Wall Street Journal*, *the New York Times*, *the Financial Times*, and other journals, for the 1991-93 period. We used key words such as "British Airways," "USAir," and/or "strategic alliance" to

extract relevant announcements associated with the alliance. Over 200 articles were collected, from which we excluded irrelevant announcements and selected the very first announcement from a group of newspapers. The reason for choosing the first one is based on the efficient markets hypothesis which suggests that the same, subsequent news will have no additional effect on the stock prices of the firms involved (Fama, 1970). Finally, we identified nine events that influenced the likelihood of the alliance being consummated. Table 1 summarizes the nine events.

Insert Table 1 about here

The first event that increased the likelihood of the alliance being materialized was announced on July 21, 1992. BA and USAir proclaimed that BA agreed to invest $750 million in USAir, which was struggling with financial problems. According to the first announcement, BA would obtain 21% of voting stock and 44% of equity in USAir and have four seats on USAir's 16-member board. BA and USAir would link their computer reservation systems and implement codesharing operations on trans-Atlantic routes. USAir would lease its three routes to BA, from Philadelphia, Baltimore and Charlotte to London, along with aircraft and flight attendants. The agreement was subject to regulatory approval from both the U.S. and the U.K. governments. About a week later (July 29, 1992), a second event occurred when Seth Schofield, chief executive officer of USAir, mentioned that the airline would contribute to the alliance. The second event appeared to increase the likelihood of the alliance being consummated.

Yet four consecutive events took place that decreased the likelihood of the proposed alliance. In August 1992, so called the "Big Three" (i.e., American, United and Delta

Airlines) started furiously lobbying the U.S. government to withdraw its likely approval of the proposed alliance (events 3 and 4). For example, Stephen Wolf, chairman of UAL Corp. (parent corporation of United Airlines), told the government, "if it approves the proposed alliance without securing a fair, balanced exchange of opportunities for its carriers, it will be the most monumental mistake that the government has ever made in air transportation" (*Wall Street Journal*, August 11, 1992). Following these events, on September 17, 1992, the U.S. Transportation Secretary demanded that the U.K. would liberalize its aviation market in return for U.S. government approval for the alliance (event 5). Furthermore, U.S. presidential candidate, Bill Clinton, said that he would not approve the proposed alliance (*Wall Street Journal*, October 30, 1992: event 6). The proposed alliance appeared to be a dead issue.

News about the proposed alliance attracted broad attention again in January 1993. According to the *Financial Times* on January 18, 1993, BA was expected to announce a revised partnership deal with USAir, following the inauguration of President Bill Clinton (event 7). On January 21, 1993, BA did indeed purchase a 19.9% voting stake in USAir for \$300 million and formed a *de facto* alliance with USAir (event 8). By reducing the size of BA's investment in USAir, two partners sought to avoid controversies over foreign ownership that caused a long delay on their previous proposal. On March 16, 1993, the U.S. administration approved BA's \$300 million investment in USAir (event 9). The administration also authorized, for a year, a computer reservation linkage and codeshared flight operations that linked USAir's domestic routes to BA's international destinations. USAir also planned to lease aircraft and crews to BA for two trans-Atlantic routes. In fact, two partners inaugurated their first codesharing flight on May 1, 1993.

We treated events 1, 2, 7, 8, and 9 as promising events, each of which increased investors' assessed probability that the alliance would be consummated. Events 3, 4, 5, and 6

were classified as discouraging events, each of which reduced investors' assessed probability that the alliance would be consummated.

Data

We collected daily stock-return data for BA and USAir (hereafter the partners) and their U.S. rivals from the Center for Research on Security Prices (CRSP) files from June 20, 1991 to March 31, 1993. We also collected equally weighted market return data from the CRSP files for the same period.

To measure the alliance impacts on rival firms, we defined the U.S. rival airlines as the airlines that provided domestic and/or international services on the same routes served by BA, USAir, or both. Relying on *Official Airline Guides: Worldwide Edition*, we identified 16 major trans-Atlantic routes served by BA. We selected seven U.S. airlines serving those 16 routes during the 1991-93 period. These rival airlines include American Airlines, Continental Airlines, Delta Airlines, Northwest Airlines, Pan Am Airlines, Trans World Airlines, and United Airlines. Using *Official Airline Guides: North American Edition,* we also identified four U.S. domestic airlines serving USAir's domestic routes, such as Alaska Airlines, Hawaiian Airlines, Pacific Southwest Airlines, and Southwest Airlines. We excluded Continental Airlines, Northwest Airlines, Pan Am Airlines, and Trans World Airlines from our sample because substantial data for these airlines were not available from the CRSP files. We also excluded Pacific Southwest Airlines from our sample because the airline cannot be regarded as a rival airline to USAir. USAir purchased the firm in 1987 and sold it to the PS Group in 1991. Since then, the PS Group has leased some aircraft to USAir. Thus, the six rival airlines were selected for our study: American Airlines, United Airlines, Delta Airlines, Southwest Airlines, Alaska Airlines, and Hawaiian Airlines (hereafter the rivals).

Table 2 shows descriptive statistics for all the airlines analyzed in this study. The combined size of the partners was approximately equal to that of American Airlines, the largest rival, in terms of revenues, operating income, or total assets in 1992. Based on the distribution of North Atlantic market shares, we dichotomized three larger rivals (American Airlines, United Airlines, and Delta Airlines) as closer rivals to the partners and three smaller rivals (Southwest Airlines, Alaska Airlines, and Hawaiian Airlines) as less close rivals.

Insert Table 2 about here

Method of Analysis

An event-study method was employed to measure the airlines' stock-price responses associated with the nine events leading to the BA/USAir alliance. In an efficient capital market, investors revise their expectations of a firm's future cash flow as they learn about events from public announcements (Fama, 1970). Hence, the returns attributable to an event associated with an alliance are composed of both investors' probability assessments for the alliance to be consummated and an estimate of the impact that the consummated alliance may have on a firm's future cash flow. The event-study method was commonly used in the accounting, economics, finance, and management literature to examine the value implications of firm-specific events (for review, see Brown & Warner, 1985; Thompson, 1985).

Following prior event studies (e.g., Chan *et al.*, 1997; Das *et al.*, 1998), we adopted the market model:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

where R_{it} is firm i's daily stock return on day t, R_{mt} is the daily stock return of the market portfolio on day t, and ε_{it} is a random-error term with $E[\varepsilon_{it}] = 0$ and $Var[\varepsilon_{it}] = \sigma_i^2$. We first

tested whether or not each of the nine events changed firms' beta coefficients. The beta coefficients were estimated as stable for all sample firms (e.g., for BA, beta = 1.47 with the 1% significance; for USAir, beta = 2.09 with the 1% significance), providing little evidence of structural changes in firms' beta coefficients due to the nine events. We then obtained the ordinary-least-squares estimates for the market model using the 250 trading days that end 20 days before event 1. For each of the nine events, we set the event day as day 0. To allow for possible information leakage prior to each announcement, we estimated two-day abnormal returns over the event window ranging from day -1 to day 0 for each of the nine events. Yet, for robustness of the analysis, we checked whether extending or contracting the event window significantly changed the signs of the sample firms' abnormal returns over the nine events. We found that the signs of the firms' abnormal returns generally remained stable for one-day window (i.e., day 0 only), two-day window (i.e., day -1 to day 0), and three-day window (i.e., day -1 to day 1).

Having estimated two-day abnormal returns to sample firms for each of the nine events, we were able to test our propositions. For the test of Propositions 1 and 2, we used t-tests to examine the individual effects of each event type (i.e., promising or discouraging). We also conducted a non-parametric test, based on a contingency-tables approach, to jointly test the effects of both event types. For the test of Proposition 3, we used both a t-test and Wilcoxson rank sum test to compare the abnormal returns of the two groups (i.e., closer rival firms *vs.* less close rivals). Yet, in testing Propositions 2 and 3, some observations were eliminated from our sample since some rival firms announced substantial price cuts during some of the nine events. It was hard to decompose the effects of the events on the rivals' abnormal returns from the effects of the price-cut announcements. From the search of the Dow Jones News Retrieval Service database, we found the following announcements made

by rival firms. During event 3, Delta announced that it would cut fares by about 10 to 30 percents to all of its 33 European destinations. American and United also announced that they would match the cuts (*The Washington Post*, August 5, 1992). This ticket-price battle was escalated by Northwest Airlines announcing fare cuts for five European destinations by up to 44 percent. During event 4, American, Delta, and United Airlines announced that they would match the cuts (*The Washington Post*, August 11, 1992). During event 5, Hawaiian Air announced that it cut round-trip fares to the West Coast to $199 from $299 in the wake of Hurricane Iniki (*Dow Jones News Wire*, September 18, 1992).

RESULTS

Table 3 presents abnormal returns to the partners for the nine events leading to the BA/USAir alliance. Overall, the partners experienced positive abnormal returns following promising events and negative abnormal returns following discouraging events (see Panel A of Table 3). The stock prices of BA increased following four out of five promising events, whereas they dropped following three out of four discouraging events. Similarly, the stock prices of USAir increased following four out of five promising events, while they decreased following all four discouraging events. On average, the partners' stock prices increased by 4.9%, 1.7%, 1.2%, and 1.6%, respectively, for the periods of promising events 1, 7, 8, and 9. In contrast, the partners' stock prices fell by an average of 0.6% to 2.9% when discouraging announcements were released.

Insert Table 3 about here

The test results for Proposition 1 are reported in Panel B of Table 3. For promising events, the average abnormal returns of the partners were estimated as 1.736% at the 10%

significance level. This implies that the value of the partners increased by an average of 1.74% due to the promising events. In contrast, discouraging events decreased the partners' abnormal returns by an average of 1.78%, which is significant at the 1% level. These findings provide support for both Propositions 1a and 1b. Similar results were obtained from a contingency-tables test. Developing a two-by-two contingency table, we classified 18 observations into four groups: i) promising events/positive abnormal returns (N=8), ii) promising events/negative abnormal returns (N=2), iii) discouraging events/positive abnormal returns (N=1), and iv) discouraging events/negative abnormal returns (N=7). The more observations belong to both cell i) rather than cell ii) and cell iv) rather than cell iii), the more likely Proposition 1 will be supported. The test result revealed strong evidence of supporting Proposition 1 ($\chi^2 = 7.73$, d.f.=1, $p<0.01$).

Table 4 reports abnormal returns to the rivals for the nine events. As shown in Panel A of the table, the rivals generally experienced negative abnormal returns following promising events and obtained positive abnormal returns following discouraging events. For the first two promising events, all rival firms experienced negative abnormal returns (except Delta in event 1). For three out of four discouraging events (events 4, 5, and 6), the rivals' stock returns slightly increased by an average of 0.13% to 0.58%. For event 7 that increased the likelihood of the BA/USAir alliance, three rival firms had negative abnormal returns. For event 8, all the rivals had negative abnormal returns ranging from -0.2% to -4.7%. On average, they lost about 3.2% due to this promising event. For the final event, three rival firms experienced negative abnormal returns.

Insert Table 4 about here

Propositions 2a and 2b were separately tested by t-tests. The test results are reported in Panel B of Table 4. The average abnormal returns of the rivals decreased by 1.22% (significant at the 1% level) following promising events. By contrast, they increased by 0.85% (significant at the 10% level) following discouraging events. These findings provide support for both Propositions 2a and 2b. Further, we tested jointly both propositions by using the contingency-tables approach. 47 observations were classified into four groups: i) promising events/positive abnormal returns (N=7), ii) promising events/negative abnormal returns (N=23), iii) discouraging events/positive abnormal returns (N=10), and iv) discouraging events/negative abnormal returns (N=7). The more observations belong to both cell ii) rather than cell i) and cell iii) rather than cell iv), the more likely Proposition 2 will be supported. The result of the contingency-tables test provided significant evidence for Proposition 2 ($\chi^2 = 5.92$, d.f.=1, $p<0.05$).

Finally, we examined whether degree of rivalry with the partners moderates the effects on the rivals' value as postulated in Propositions 3a and 3b. To do so, we divided the rivals into two groups. As mentioned earlier, based on the level of competition in North Atlantic markets, American, United, and Delta were classified as closer rivals and Southwest, Alaska, and Hawaiian as less close rivals. Table 5 compares the average abnormal returns between these two sets of rival firms. Unlike Proposition 3a, promising events did not decrease the value of the closer rivals (-0.95% with the 5% significance level) more than the value of the less close rivals (-1.48% with the 5% significance level). Besides, discouraging events did not increase the value of the closer rivals (-0.54%) more than the value of the less close rivals (1.61% with the 5% significance level). Hence, this result does not support Proposition 3b. Similar results were obtained from the Wilcoxon rank sum test, providing no support for Propositions 3a and 3b.

Insert Table 5 about here

DISCUSSION AND CONCLUSION

The study examines changes in partner firms' and their rival firms' value in reaction to both promising events (i.e., announcements that increase the likelihood of an international alliance being consummated) and discouraging events (i.e., announcements that decrease that likelihood). Our results confirm that both promising and discouraging events matter for the value of partner firms as well as rival firms. We find that promising events increase the abnormal returns of partner firms by 1.74% (Proposition 1a) whereas discouraging events decrease them by 1.78% (Proposition 1b). These findings suggest that firms entering alliances expect that the potential benefits of the alliances exceed the potential costs and the stock market confirms such an expectation. That is, investors in the stock market expect that the alliances, once consummated, will add value to the participating firms. Accordingly, partner firms' abnormal returns rise following promising announcements about a future alliance while they fall following discouraging announcements.

Both promising and discouraging announcements, however, affect rival firms' value to the opposite direction. It is found that promising events decrease the abnormal returns of rival firms by 1.22% (Proposition 2a) whereas discouraging events increase them by 0.85% (Proposition 2b). These findings indicate that promising events are perceived as bad news to rival firms whereas discouraging events as good news to the rivals. This further implies that investors in the stock market expect that the formation of alliances will facilitate competitive environments rather than collusive ones. If investors believed that collusive environments were created by an alliance through partner firms' tacit collusion in pricing, rival firms would

benefit from the decreased competition (Scherer & Ross, 1990; Tirole, 1988) and the value of rival firms would increase (decrease) following promising (discouraging) events. Hence, our results on Propositions 1 and 2 suggest that an international alliance appears to strengthen the competitive positions of partner firms through cost-sharing, risk-sharing, information-sharing, and various complementary activities. Moreover, the enhanced competitive edges of partner firms appear to deteriorate rival firms' competitiveness through increased competition, resulting in decreases in the rivals' value.

Yet, our further analyses concerning degree of rivalry with partner firms provide no support for Proposition 3, that is, promising (discouraging) events decrease (increase) the abnormal returns of closer rival firms more than those of other rival firms. We find that promising events decrease (although insignificant) the value of less close rivals more than that of closer rivals, whereas discouraging events increase (significant at the 5% level) the value of less close rivals more than that of closer rivals. These results imply that firm size rather than degree of rivalry may moderate the effects of alliance announcements on rival firms' value. As indicated in Table 2, the closer rivals are larger than the other rivals. Firms entering alliances can risk the competitive positions of smaller rivals than those of larger rivals since the larger rivals have more resources and capabilities than the smaller rivals to defend their competitive positions from the strengthened partner firms. As a result, the value of the smaller rivals is more sensitive than that of the larger rivals to both promising and discouraging announcements of an alliance, since investors expect that the consummated alliance will damage smaller rival firms more severely than larger rival firms. In a similar vein, some previous studies found that, from a specific alliance, relatively smaller partner firms benefited significantly more than larger partners (Chan *et al.*, 1997; Das *et al.*, 1998; Koh & Venkataraman, 1991). Yet, these are subject to further investigation.

This study has several theoretical and practical implications. At the theoretical level, the study makes an original contribution to alliance research by investigating the value implication of rival firms' alliances. It is of great interest for both managers and scholars to understand strategic implication of rival firms' alliances. However, despite its importance, the issue of whether or not the value of firms is jeopardized by their rivals' alliances has received little attention in the literature. Secondly, the study makes a methodological contribution by using a longitudinal approach rather than a cross-sectional approach in examining the effects of alliance announcements on firm value. Previous studies that used cross-sectional approaches focusing on only the final announcements of alliance formation demonstrated that the value of partner firms generally increased following the final announcements (Chan *et al.*, 1997; Das *et al.*, 1998). This study further illustrates that both previous and final announcements affect the value of partner firms as well as their rivals. The results from our longitudinal approach suggest that the overall effects of international alliance formation on firm value should be derived from all announcements leading to the alliance formation. At the practical level, this study reveals managers that a firm's poor response to ongoing alliance formation progressed by its rivals can jeopardize its stock value and future profitability. Moreover, this study shows that smaller firms may be more vulnerable than larger firms to rival firms' international alliances, although it is subject to further tests.

Some limitations of this study guide researchers for future studies. This study considers only one moderating variable, degree of rivalry with partner firms, in examining the effects of alliance announcements on rival firms' value. There may exist other moderating variables such as firm size, financial status, product mix, and strategic similarity. Future studies can concentrate on competitor characteristics and identify which factors moderate the effects of international alliance announcements on rival firms' value more significantly.

Another limitation of this study is the limited number of observations due to our longitudinal research requirement. As mentioned earlier, the setting enables us to examine sequential changes in firm value in response to a series of promising and discouraging announcements leading to the ultimate announcement of alliance formation. Yet, this setting significantly confines the available sample size for this study. As a result, the limited number of available observations may deteriorate the statistical test results for our propositions. Overcoming these issues provides more opportunities for interesting future research.

The negative effects of alliance formation on rival firms' value can be better understood by investigating conditions under which the impacts are stronger or weaker. This contingency approach on the alliance impact on rival firms provides more practical implications to field managers in several industries. Finally, a global economy makes international alliances more important since intensified competitive pressures force firms to focus on their core skills and competencies. Thus, international alliances are one of the fastest strategic alternatives to access or utilize external resources in other countries. Future research may investigate whether cultural distance between partner firms moderates current findings (e.g. Barkema & Vermeulen, 1997), whether economic development status between partner countries makes any significant impacts, and whether alliances within a specific geographic region have any differences from other alliances between different geographic regions.

To conclude, this study sheds additional light on alliance research in a sense that it investigates international alliance impacts on rival firms as well as partner firms. Considering mixed findings from previous studies examining alliance performance itself, we believe that this study contributes in a fundamental way to the study of inter-organizational alliances as well as strategic management of international alliances.

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TABLE 1
Events leading to the alliance between British Airways and USAir

Event	Announcement day	Event description
A1 (+)	7/21/92	British Airways (BA) and USAir announced a proposed deal in which BA would invest $750 million in USAir and the two airlines would form a strategic alliance. Source: *Dow Jones News Service.*
A2 (+)	7/29/92	The CEO of USAir said, "USAir is a very equal participant in the BA/USAir alliance and we have a lot of values." Source: *Washington Post.*
A3 (-)	8/4/92	American Airlines and Delta Airlines said that the U.S. government should not approve BA's plan to invest $750 million in USAir unless the U.S. secures equal opportunities for U.S. carriers. Source: *Dow Jones News Service.*
A4 (-)	8/11/92	American Airlines and United Airlines have advised the U.S. Department of Transportation that they will fight the proposed BA/USAir alliance. Sources: *Wall Street Journal* and *Dow Jones News Service.*
A5 (-)	9/17/92	U.S. Transportation Secretary, reversing his position, signaled that the U.S. may demand aviation concessions from Britain in connection with the plan by BA to take a stake in USAir. Source: *Wall Street Journal.*
A6 (-)	10/30/92	U.S. presidential candidate, Bill Clinton, opposed the proposed BA/USAir alliance. The U.S. administration pressed Britain to liberalize its aviation market but the talks between U.S. and British officials ended yesterday without an agreement. Source: *Wall Street Journal.*
A7 (+)	1/18/93	BA and USAir were expected shortly to announce a revised partnership deal. Source: *Financial Times.*
A8 (+)	1/21/93	BA bought a 19.9% voting stake in USAir, for $300 million. At the same time, the partners set up a 2-step structure under which BA could increase its investment over next 5 years to a total $750 million and its equity ownership to 44%. Sources: *Wall Street Journal* and *Dow Jones News Service.*
A9 (+)	3/16/93	The U.S. administration approved the revised BA/USAir alliance. The administration also authorized for one year a computer reservation and codesharing agreement. The new partners would begin code-sharing on May 1. Source: *Financial Times.*

(+) refers to promising events, each of which increased the probability of the alliance, and (-) refers to discouraging events, each of which decreased the probability.

TABLE 2
Descriptive statistics for sample firms for the year 1992

	1. Revenues ($M)	2. Operating income ($M)	3. Total assets ($M)	4. Total debt ($M)	(2)/(1)	(4)/(3)	North Atlantic market share[a]
• Partners							
BA	8,399	939	9,587	7,584	0.11	0.79	0.12
USAir	6,686	97	6,595	4,698	0.02	0.71	0.02
• Rivals							
American	14,396	955	18,706	12,558	0.07	0.67	0.09
United	12,890	195	12,257	8,458	0.02	0.69	0.07
Delta	10,837	-39	10,162	6,375	-0.04	0.63	0.11
Southwest	1,685	291	2,293	1,068	0.17	0.47	0.00
Alaska	1,115	3	1,208	824	0.03	0.68	0.00
Hawaiian	395	-59	106	206	-0.15	1.95	0.00

[a]The market shares are computed based on 1993 scheduled revenue passengers.
Sources: COMPUSTAT.
IATA (International Air Transport Association) North Atlantic Passenger Traffic Report (1994).

TABLE 3
Abnormal returns to partner firms and test results for Proposition 1

Panel A: *Abnormal returns to partner firms*

Partner firms	Sequence of events leading to the alliance								
	A1 (+)	A2 (+)	A3 (-)	A4 (-)	A5 (-)	A6 (-)	A7 (+)	A8 (+)	A9 (+)
BA	-1.003	1.733	-0.130	-1.096	-2.461	0.483	0.030	0.116	1.211
USAir	10.722	-3.116	-1.038	-3.715	-3.407	-2.837	3.451	2.187	2.027
Average	4.860	-0.692	-0.584	-2.406	-2.934	-1.177	1.741	1.152	1.619

Panel B: *T-test results for Proposition 1*

Type of event		Average abnormal returns to partner firms (%)				Proportion of positive abnormal returns
		Mean	Standard error	Min	Max	
(+) event	(N=10)	1.736*	1.159	-3.116	10.722	0.90
(-) event	(N=8)	-1.775***	0.548	-3.715	0.438	0.12

*p<0.1, ***p<0.01 for a one-tailed t-test of H0: no abnormal return *vs.* P1.

TABLE 4
Abnormal returns to rival firms and test results for Proposition 2

Panel A: *Abnormal returns to rival firms*

Rival firms	Sequence of events leading to the alliance A1 (+)	A2 (+)	A3 (-)	A4 (-)	A5 (-)	A6 (-)	A7 (+)	A8 (+)	A9 (+)
American	-1.264	-0.623	-0.852	-2.230	-0.017	-2.076	-0.755	-2.725	-0.317
United	-0.318	-3.828	-1.456	0.721	1.213	0.447	-0.431	-2.738	1.251
Delta	0.074	-1.073	-1.468	-5.093	-0.351	-2.449	1.926	-2.973	-0.484
Southwest	-1.394	-4.766	-2.143	4.446	2.739	-0.316	0.117	-4.685	-0.050
Alaska	-2.710	-1.084	0.144	-1.116	1.714	3.520	-1.616	-0.218	2.259
Hawaiian	-3.521	-0.558	1.850	5.195	-1.792	1.642	1.792	-6.101	0.361
Average	-1.522	-1.989	-0.655	0.321	0.584	0.128	0.172	-3.240	0.503

Panel B: *T-test results for Proposition 2*

Type of event	Average abnormal returns to rival firms (%) Mean	Standard error	Min	Max	Proportion of positive abnormal returns
(+) event (N=30)	-1.215***	0.371	-6.101	2.259	0.23
(-) event (N=17)[a]	0.850*	0.547	-2.449	5.195	0.59

[a]The rival firms' abnormal returns shaded in Panel A are excluded from the test of P2b since the rivals leased their own announcements such as substantial price cut during the events.
*p<0.1, ***p<0.01 for a one-tailed t-test of H0: no abnormal return *vs*. P2.

TABLE 5
Degree of rivalry and test results for Proposition 3

Panel A: *Abnormal returns to close and less close rival firms*

Rival firms	Sequence of events leading to the alliance								
	A1 (+)	A2 (+)	A3 (-)	A4 (-)	A5 (-)	A6 (-)	A7 (+)	A8 (+)	A9 (+)
Closer rivals	-0.503 (N=3)	-1.841 (N=3)	n/a	n/a	0.282 (N=3)	-1.359 (N=3)	0.247 (N=3)	-2.812 (N=3)	0.150 (N=3)
Less close rivals	-2.542 (N=3)	-2.136 (N=3)	-0.050 (N=3)	2.842 (N=3)	2.227 (N=2)	1.615 (N=3)	0.098 (N=3)	-3.668 (N=3)	0.857 (n=3)

n/a: not available

Panel B: *T-test results for Proposition 3*

Type of event	1. Abnormal returns to closer rivals (%)		2. Abnormal returns to less close rivals (%)		(1) - (2) (%)	
	Mean	Standard error	Mean	Standard error	Mean difference	t-statistic
(+) event (N=30)	-0.952** (N=15)	0.405	-1.478** (N=15)	0.630	0.526	0.70
(-) event (N=17)	-0.539 (N=6)	0.587	1.607** (N=11)	0.696	-2.146**	-2.36

**p<0.05 for a two-tailed t-test of H0: no abnormal return.

Intransit Preclearance at Canadian Airports

Prepared for the 3rd Air Transport Research Group, Hong Kong, June 1999

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Abstract:

Customs preclearance facilities are a distinctive feature of the larger Canadian airports. Passengers can clear US Customs while still on Canadian soil. This provides a benefit to US airlines because it eliminates delays in passenger transfer at their hubs. Intransit preclearance facilities allow for the transfer of international passengers from intransit lounges through US preclearance facilities, without requiring them to officially enter Canada. This arrangement allows airports like Vancouver to compete as international hubs for US-destined passengers. The establishment of intransit preclearance was a key demand in the Canada-US Open Skies negotiations in 1991-92, but was opposed by some US stakeholders, and was specifically not addressed in the 1995 Open Skies Agreement. This paper describes the concept, and the negotiations that led to the 1998 agreement on intransit preclearance, and issues that arose in the creation of domestic enabling legislation.

Intransit Preclearance at Canadian Airports

Introduction

The intransit preclearance accord of 1998 resolved the last key issue that Canada had sought to address in the 1991-92 air service negotiations with the United States. Although specifically addressed in the Elliot-Kaplan Framework talks, the issue had been excluded from the 1995 Open Skies Agreement.

This paper discusses the concept and development of preclearance and its effects on the transborder market. The importance of the issue in the air service negotiations of 1991-92, and the difficulties this posed for the US-DOT are examined, since intransit preclearance was one of the key unresolved issues when the talks collapsed. The Elliot-Kaplan Framework Talks of 1994 all but established the 1995 Open Skies Agreement, but intransit preclearance was excluded with the belief both trade and diplomatic issues could be negotiated more effectively if treated separately.

The establishment of a pilot project in Vancouver preceded the implementation of Canadian enabling legislation. This arrangement struck a delicate balance between the needs of US Customs and the Canadian requirements that US law not be applied extraterritorially and that it not abridge the rights guaranteed in the Canadian Charter of Rights and Freedoms. The Senate of Canada passed the *Preclearance Bill* in April 1999. Concerns raised by the Canadian Bar Association and the changes made in Senate are also examined.

The Development of Intransit Preclearance

The Preclearance Agreement

Preclearance facilities became a feature of the Canada-US transborder in 1952, but the arrangement was formalized in the 1974 Preclearance Agreement. The arrangement has been in place so long that it few Canadians flying across what has is often referred to as "the world's longest undefended border" even recognize its distinctiveness.[1] Travelers entering the US from Canada are "pre-cleared" by US federal inspection agencies while on Canadian soil. These agents may deny a traveler the right to enter US, but may not extraterritorially apply US law, meaning that they have more limited search and seizure powers than they would have on US soil.

The arrangement has been criticized over the years, and Canadian carriers have occasionally called for its repeal. This stems from the contention that it benefits only competing US carriers. Passengers at the US arrival airport do not have to clear customs, which would otherwise induce delays in transferring passengers at the hubs for US carriers. Since Canadian carriers do not carry passengers beyond the initial US airport, this presents no benefit to them. Since preclearance facilities do not exist in the US, they have to clear their US origin passengers at their Canadian hub airports before they travel on to other domestic destinations.

[1] The United States has preclearance facilities in Canada (25 U.S.T 763; T.I.A.S No. 7825), Bermuda (25 U.S.T 288; T.I.A.S No. 7801), and Bahamas (26 U.S.T 646; T.I.A.S No. 7816).

Successive Canadian governments, of all stripes, have ignored these complaints. Perhaps because clearing foreign customs in one's own country is reassuring, or perhaps because it is more convenient to go through this procedure at the beginning of the journey, Canadian consumers like preclearance.

Intransit Preclearance in the 1991-92 Transborder Negotiations

The bilateral in place at the beginning of the 1991-92 air service agreement (ASA) talks had been in place since 1966, with minor alterations concluded by way of diplomatic notes. The 1966 agreement had been so contentious that only by the intervention of the Canadian Prime Minister, the US President, and John Kenneth Galbraith (a Canadian-born economist and former US ambassador) was the agreement concluded at all.[2]

The 1966 agreement pre-dated US and (somewhat later) Canadian domestic airline deregulation, and the hub-and-spoke routing systems that it spawned. Many stakeholders felt that the rigidity of the bilateral was restricting air service development and limiting the economic benefits of the Canada-US Free Trade Agreement (and later, NAFTA). There was appetite for change on both sides of the table, but that is where the agreement ended.

The US Department of Transportation (US-DOT) sought an 'Open Skies' agreement with unrestricted international freedoms, including 'beyond rights', and no capacity restrictions. If this were not on offer, the US carriers were fragmented on which markets and routes that were to be sought and offered. Management of these many interests was a significant challenge to the development of cogent positions.

Canadian carriers, with considerably different market access under the 1966 agreement, and locked in bitter rivalry in which the survival of Canadian Airlines hung in the balance, were predictably at odds over what should be on the table.[3] Air Canada stood to gain very little from the negotiations.[4] After 50 years of government favoritism, it had every route authority it had a strong interest in, with the exception of Toronto-Washington National. Canadian, with few US route authorities, wanted a larger share.

The key Canadian demands did not change throughout the period. There were issues related to access to slots at congested US hubs, "safeguards" issues, which came to be

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[2] However difficult the negotiations leading up to the 1966 agreement had been, Galbraith found the negotiations less onerous: "I went into a room. I talked with myself, and I came out with a deal" (Blanchard. (1998) Behind the Embassy Door: Canada, Clinton and Quebec, p. 162).

[3] See Kaduck (1996) Break in Overcast: the Negotiation of the 1995 Canada-US Open Skies Agreement for a detailed description of bargaining issues, using a Putnam two-level game analysis.

[4] Interestingly, Air Canada changed its view of the transborder and has proven to be the most aggressive player in the market. Kaduck (1997) Canadian Carrier Strategies and the 1995 Open Skies Agreement, describes the changing approach to the market.

understood as a need for phase-in periods in US access to the three Canadian hubs, and intransit preclearance.

Intransit preclearance was an augmentation of the preclearance agreement that would allow passengers originating outside Canada and bound for the US, to enter US preclearance facilities without first clearing Canadian Customs and Immigration. The advantage of such an arrangement would be that Canadian carriers could then compete for non-hub traffic in the US, using a Canadian hub, without an innate competitive disadvantage.

For example, a Kansas City passenger bound for London does not have the option of a non-stop flight, and will have to transfer at a hub airport. Air Canada operates Kansas City-Toronto and Toronto-Heathrow direct flights, and so may compete for that passenger's business with US carriers who transfer passengers at Chicago, New York or Pittsburgh. Outbound there is no particular difference between a flight over the Toronto hub or a US hub. The passenger clears UK Customs at Heathrow. If the transfer is made in Toronto, the passenger remains in the in-transit lounge, and never enters Canada.

The return trip is a different matter. In the case of a US hub airport, the passenger must clear US federal inspection agencies at the port of arrival, before continuing to the final destination. At Toronto, US-bound passengers have to clear Canadian Customs first, and then enter US Customs preclearance, even though they have no intention of entering Canada. In other words, the reason for the problem is the very existence of the pre-clearance facility. Carriers may not take cleared and uncleared passengers on the same flight, therefore all passengers must be pre-cleared which, under the current arrangement, means that all passengers must be legally in Canada before entering US preclearance. The problem is exacerbated if Canada has a visa requirement for persons of the traveller's nationality.

Canadian carriers felt that this diminished their ability to compete for passengers against US competitor airlines, even though they had route authorities that allowed them to offer such services. They also felt that the putative advantage US carriers gained by the preclearance arrangement contributed to a diversion of Canadian passengers. US airlines carried more than 60 percent of Canadian origin traffic to the US. Intransit preclearance, it was argued, would help offset this imbalance.

For a number of reasons, the 1991-92 talks broke down after 18 rounds with virtually no progress on any of these issues. Furthermore, the negotiations had been so rancorous that neither side had much appetite for a repetition of the process.[5]

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[5] The level of bitterness was high on both sides. US Ambassador Blanchard, who was instrumental in the achievement of the 1995 agreement, was initially told by his bureaucrats that he was wasting his time on the file (Blanchard, p. 166). The Canadian view was that the US negotiators were always willing to accept their own terms, but had made few substantive concessions in 18 rounds in 1991-92.

The Elliot-Kaplan Framework and the 1995 Open Skies Agreement

In 1994, the Clinton administration, and the newly installed Chretien government in Ottawa decided to see if there was potential for even a few of the issues to be resolved. Secretary Federico Peña and Transport Minister Doug Young were both inclined to see the ASA modernized, but Young, leading an aggressive commercialization and deregulation of Canadian domestic transportation, was unwilling to invest resources in what had been, traditionally, a contentious and non-productive process.

At an initial meeting, the two senior officials reached an agreement on process. Each government would send a single negotiator to conduct exploratory and non-binding approaches to the various issues. The delegates would produce recommendations, and only after substantial agreement was reached would full negotiation teams meet to hammer out the details.

The two negotiators, Geoffrey Elliot and Steven Kaplan, were both well acquainted with the file, but had not had substantial involvement in the previous failed talks. Elliot, a former Canadian Chief Air Negotiator, had retired from the diplomatic service to take a vice-presidency at a large forestry firm. Kaplan was US-DOT Legal Counsel. In a few meetings over the course of several months, the two produced the so-called "Framework Document", which in 13 pages delineates the substance of the 1995 ASA.

One key issue was detached from the Framework. Intransit preclearance could only be implemented with the agreement of US Customs, and the significant issues it had raised in the 1991-92 talks had contributed to both the failure of the talks and the bitterness of many Canadian stakeholders. No matter what the economic arguments in favour of liberalization, US-DOT had no leverage over Customs, and there was a very real fear that the scenario would repeat itself if Customs could use the leverage of the negotiations to press its demands.

Elliot's brief from Minister Young had been clear. He was to bring back an agreement that was assured of success, or no agreement at all. Elliot and Kaplan had solved the other contentious issues, but intransit preclearance was a potential showstopper. At this point, Canada took a significant gamble. Severing the issue of intransit preclearance, and leaving it to a separate diplomatic negotiation process was the only way of preserving the benefits to both parties contained in the Elliot-Kaplan Framework.[6] If the subsequent negotiations failed, Canada would lack an issue big enough to bring the US back to the trade table. Within a year, as the Framework document had agreed, the countries met to discuss the means by which intransit preclearance could be achieved.

[6] Government of Canada. (1994) Framework for Resumption of Canada-US Transborder Air Negotiations.

Issues and Solutions

US Customs Issues

There was no single Customs-related issue that dominated the 1991-92 talks. Some of the more contentious issues had no relationship to air transport, but represented a blatant attempt by US Customs to extract tax and duty concessions for its personnel. Others were legitimate attempts to achieve the enforcement powers that Customs officers enjoy on US soil. The former produced resentment, while the latter presented difficult legal challenges, since they touched on the sensitive issue of sovereignty, and in particular, because they ran afoul of Canada's Charter of Rights and Freedoms.[7]

The issue of search and arrest powers was perhaps the most significant challenge. US Customs is a law enforcement agency. It is charged with the duty of defending US borders against criminals and dangerous aliens. The US Customs web site, for example, advertises the service as "America's Frontline". US border guards are armed for protection against the elements they seek to interdict: drug smugglers, international criminals and terrorists.

Canadian Customs also has these duties but in the context of Canadian law they are civil servants, not police officers. They have the power to detain persons suspected of criminal acts until police officers arrive, but they do not have the broad arrest, search and seizure powers the US grants its Customs officers, and they are not authorized to carry weapons. There is therefore a great divide between what Canada and the US consider to be reasonable Customs activities.

The further complication is that the broad powers US grants its Customs officers clearly contravene the legal guarantees contained in the Canadian Charter of Rights and Freedoms. Canadian police officers are considerably more restricted with respect to searches and detention of suspects, and the Charter guarantees right to legal counsel, which is not the case in US Customs law. "Probable cause" is also more restricted in Canadian law and precedent and foreign law enforcement officers, of course, have no powers at all.[8]

At the root of these concerns lay the fact that, because preclearance facilities are not on US soil, if the a person chose to walk away rather than submit to a search by Customs, there was no way of detaining them. This incensed Customs officers, who felt that they

[7] The Charter of Rights and Freedoms became law in 1982, thirty years after preclearance began at Toronto and six years after the Preclearance Agreement. The Charter guarantees legal rights of people in Canada, not only citizens.

[8] On the other hand, as the Canadian Bar Association points out, the US also enjoys the advantage of being able to enforce their laws in an area in which their own constitutional protections are not available to the traveller, and where deportation is less costly (The Senate of Canada. (1999) Proceedings of the Standing Senate Committee on Foreign Affairs Issue 30 – Evidence p. 2). The present author doubts that US Customs would systematically deny US rights under these conditions any more than Canadian Customs would cease to apply the Charter rights merely because they were on foreign soil.

were handicapped in the performance of their duty to apprehend any person who attempted to enter the US in violation of any US law.

US Customs also felt that there was a substantive difference between travellers who were entering from Canadian soil and those who were not. Entering from Canada meant that either they were either citizens of Canada or the US or, at one time or other, had been subject to Canadian Customs screening. Intransit preclearance, it was argued, allowed passengers an avenue for entering the US in which there was a lower standard of enforcement available to the US, and for which it was more difficult to prepare. Some form of pre-screening mechanism based on ticket or computer reservation system (CRS) data would assist Customs in separating the most likely potential law-breakers from the others.

This was a difficult issue under Canadian law because of privacy rights and issues related to potential discrimination inherent in any sort of profiling. Information disclosure was also a concern to the airlines because not only was it proprietary data, but disclosure might lead to litigation based on invasion of privacy, or be a disincentive to passengers who considered it unreasonably invasive.

US Customs had also demanded the right to carry firearms, but that was a political non-starter in Canada, as it would have been in virtually any country. US government personnel enforcing US law on Canadian soil was similarly infeasible. Both of these issues were seen as vital to performance of Customs mandate. They argued that preclearance on Canadian soil ought not to mean that the Customs officers were not allowed to perform their duties to the same extent as they would at any other port or border crossing point. While history was not on their side, linkage to an important trade negotiation allowed US Customs to re-argue a traditional grievance. The 1991-92 negotiations produced no solution, however, and probably more firmly entrenched Canadian officials.

The other issues brought by US Customs were less substantive. It was argued, for example, that their personnel should have the right to import substantial amounts of US goods duty-free. The rationale for this was somewhat opaque to Canadians, since the Customs officers are clearly not diplomatic personnel. Ambassador Blanchard later attempted to broker exemptions from sales tax for Customs agents in exchange for preclearance facility in Ottawa. He was surprised that Ottawa officials did not more enthusiastically receive this subsidy proposal, which he describes as 'win-win' and 'sensible'.[9]

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[9] Blanchard, pp.174-175. The maneuver speaks to the difficulty in getting Customs to buy into a trade-enhancing mechanism. Even though the deal was in the interest of US carriers, Customs would have to spend money on it and, as Blanchard puts it, "Clearly they had to have something in return" (p.174). The issue was later solved, on the US side, by H.R. 3644, which allowed for the elimination of spending authority limitations by allowing user fee proceeds to fund preclearance facilities, even if fees were not collected there (Air Transport Association (1997) Statement of Carol Hallett, President and Chief Executive Officer, Air Transport Association of America, before the House Ways and Means Committee's

Canadian Legal and Political Issues

The mere presence of US Customs at the table in 1991-92 still raises hackles among many of the Canadian participants. Customs' contribution was considered at best irrelevant, and often undesirable. The air transport stakeholders had little patience for lengthy pontifications by Customs on why its officers needed the right to carry firearms, for example. They were there to trade aviation goods for aviation goods.

Extraterritoriality is almost always controversial. Under international law there are few exceptions to the rule that another laws of one state cannot be enforced on the soil of another. Canada had never ceded jurisdiction in the preclearance areas, and any perception that this was the case would have been the death of the arrangement. Canadians preserve their sense of national identity with great vigour, especially where the United States is involved. Despite almost 200 years of peaceful coexistence, the fear of US domination is never far from the surface, and Canadians are never more self-righteous than they are on this topic.

These general differences were compounded at the time of the 1991-92 talks by a simmering conflict between Canadian carriers and US Customs. The airlines argued that Customs was interpreting and enforcing the existing agreement in a manner that deliberately discriminated against them.[10] This was seen as a blatant attempt to support US carriers in the transborder charter market, which Canadian carriers dominated, and which was the only segment of the market in which they had a cost advantage.

Intransit Preclearance Negotiations

As Kaplan and Elliot had hoped, the severance of Customs issues from the main trade negotiation allowed the rapid development of the 1995 'Open Skies' agreement, which was signed in February 1995. Neither side attempted to change any substantive part of the Framework Agreement, and DOT was able to achieve its objectives without relying on the consent of Customs. The economic benefits were significant for both sides, and the market grew at double-digit rates for the next three years.[11]

Subcommittee on Trade, on US Customs Service Passenger and Merchandise Processing Issues). This legislation, and the continued maintenance of preclearance facilities, was endorsed by the employees union (Statement of Robert M. Tobias, National President, National Treasury Employees Union, Committee on Ways and Means, Subcommittee on Trade, 4-30-98). Airlines are charged the 'reimbursable excess cost' [the cost of preclearance in excess of the cost that would have been incurred to process the passengers in the US] of the preclearance locations outside the US by a prorated formula (19CFR24.18).

[10] Customs had unilaterally interpreted a clause requiring 90 days advance notice of schedule changes in the most restrictive fashion. For example, an additional aircraft flying the same schedule would require 90 days notice. Charter operators, who require flexibility in their operations, perceived this as selective interference.

[11] The volume of US-Canada air traffic increased 37.2% from 12.1 mil passengers in 1994 to 16.6 mil passengers in the 12 months ended 8/97. Open Skies Pact Boon to Canada, U.S. Aviation Week & Space Technology, March 02, 1998.

Intransit Preclearance at Canadian Airports

The Framework Agreement called for the commencement of negotiations on intransit preclearance within a year of the agreement coming into force.[12] The resulting negotiations were time-consuming and difficult, but eventually reached an approach that was acceptable to both sides. Before the domestic legislative changes were made, a pilot project was commenced to demonstrate the viability of the concept, and the benefits it could provide.

The Vancouver Intransit Preclearance Pilot Project

The pilot project in Vancouver (YVR) airport began in July 1997. The site was important because of the airport's strategic location in the Asia-Pacific market. YVR's airport authority had recently built an international terminal addition specifically designed to accommodate intransit preclearance.

The location was also significant to the repositioning of Canadian Airlines as an Asia-Pacific carrier.[13] Canadian Airlines International Limited (CAIL) is partly owned by American (AMR Corp.) and has significant route authorities and favourable slot times in Asian markets in which American has little presence. The potential for feeding Asian traffic on code-shared CAIL flights over the Vancouver hub, and onward to American's US route system was limited only by the double-visa requirements which would be applied to many passengers if they were required to enter Canada enroute to the US.

The YVR Corporation also pointed out on every available occasion that Vancouver was actually several hours closer than Los Angeles or San Francisco to key Asia-Pacific markets. Passengers from Miami or American's Latin American markets could be spared the added travel time if their hub were used rather than the California airports.

The arrangement was also supported strongly in the US. The Air Transport Association hailed it as a 'very important step' and one that would 'establish Vancouver International as an intransit gateway to North America'.[14]

The Preclearance Act of 1998

The Preclearance Act[15] was brought before Parliament for first reading in December of 1998. It contained a series of carefully crafted compromises meant to preserve Canadian

[12] A working group was tasked with determining, by 1 March 1996, how 'one-stop' pre-clearance could be achieved. Government of Canada (DFAIT) *Canada Welcomes New Preclearance Arrangements with the U.S.*, December 22, 1995. The process that led up to the formation of this working group is described in Blanchard pp. 174-177. The Ambassador was eager to get a new preclearance facility in Ottawa for the primary benefit of US carriers, but describes the Canadian insistence that this be dealt with in the larger preclearance context, including intransit preclearance, as "demanding something new at the last minute".
[13] CAIL was restructured in late 1997, which included the extraction of significant concessions from its workers and tax concessions and loan guarantees from various levels of government. Its business plan calls for a reorientation of its capacity to better serve the Asia-Pacific market it pioneered 50 years ago.
[14] Air Transport Association. (1997) ATA Supports Customs Agreement with Canada.

sovereignty and the application of Charter rights, while allowing US Customs increased facility to do its national duty.

The summary describes the structure of the bill explicitly. Human rights issues are covered by the statement that the laws are administered

> subject to the *Canadian Charter of Rights and Freedoms*, the *Canadian Bill of Rights* and the *Canadian Human Rights Act*.
>
> No provision of American law that would be criminal under Canadian law may be administered in Canada. Criminal matters must be dealt with by Canadian authorities under Canadian law.

The basic framework constructed within the bill is one in which a series of enabling provisions are made which allow US Customs to perform its functions to the extent legal within Canadian law. Any criminal matters which may arise prosecuted under Canadian law, and administrative penalties under the US Customs law may still be applied – though these cannot be applied for the same offence.

The duties of the authorities of each country are occasionally interlinked, but this is clearly defined. For example, "frisk searches" may be conducted by US Customs, however strip searches may only be carried out under Canadian law and by Canadian authorities. Where US Customs requires a strip search, they may detain the traveller until Canadian authorities arrive.

Discussions and Changes in the Senate

The proposed Bill S-22 was tabled for First Reading of in the Canadian Senate in December 1998. The Senators heard testimony, on 17 February 1999, from civil servants from the Department of Foreign Affairs and International Trade (DFAIT) and from Canadian Airlines. The remainder of the stakeholders who had made their intention to testify known were also known to be in favour of the bill as it stood, and written statements were called for in place of verbal testimony. Senator Grafstein noted, however, that the Canadian Bar Association (CBA) had not vetted the bill, and suggested that it should be asked for comment.[16]

The CBA made its submission in March, noting that this was a preliminary comment, as the association had not been involved in the drafting of the legislation before then. A number of issues were raised, and were considered by the Senate, but despite these concerns, the CBA made clear that it felt that "legislation that clarifies and codifies the

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[15] The Senate of Canada. (1998) Bill S-22. An Act authorizing the United States to preclear travellers and goods in Canada for entry into the United States for the purposes of customs, immigration, public health, food inspection and plant and animal health.

[16] Proceedings of the Standing Senate Committee on Foreign Affairs Issue 28 – Evidence, p. 25.

preclearance process ... is long overdue".[17] The lack of such legislation had already raised issues about the legality of the existing extra-territorial activities.

This having been established, the CBA stated that it could not endorse the bill in its original form. It questioned the propriety of granting law enforcement powers to a foreign government that was not accountable to the domestic legal system, and of allowing search, seizure and use of force by its officers. The requirement to submit to such authorities and the lack of provision for voluntary withdrawal from the area raised serious Charter concerns. The lack of safeguards such as clear indication of the rights of the passenger under Canadian law, denied "meaningful access" to the Charter rights and freedoms. In particular, the CBA brief questioned the propriety of creating criminal liability for persons who do not appear before the preclearance officer or for "assenting" to the making of a deceptive oral statement.

All of these inadequacies in the bill could, in the opinion of the Bar Association, be remedied while keeping the social benefits without "sacrificing essential rights and freedoms or extending criminal liability unreasonably".[18] This would include a clear definition of the duties of a preclearance officer, which is necessary in order to determine what 'obstruction' of such duties might entail. Further definition was also required for the manner in which US law, which might be amended at any time by the US, would be administered if a 'conflict of laws' arose. It therefore recommended that any provision for the enforcement of US laws on Canadian soil be deleted entirely. It expressed doubts that the US would ever be willing to enact similar laws on its own soil and, using the example of NAFTA, went on to suggest that the Canadian bill not be enacted until a reciprocal legislation was adopted in the US.[19]

The CBA found difficulties with the section on monetary penalties. The US levies fines for a variety of offences and, in the previous year, there had been a well-publicized case in Calgary airport in which US Customs was characterized as exceeding its authority in the collection of such fines.[20] The recommendation of the CBA was that the bill be amended to preclude the levying of US administrative fines in the preclearance area, to ensure that there was no legal basis for the recovery of such fines in Canada, and to

[17] Canadian Bar Association. (1999) Submission on Bill S-22 The Preclearance Act, p. 2.
[18] Ibid. p. 4.
[19] Ibid. p. 5-6. The North American Free Trade Agreement provisions were mirrored in the respective domestic enabling legislations.
[20] There had been much outrage in the Canadian press over the case of a traveller who, having been assessed a fine by Customs for possession of marijuana, was escorted to an automatic teller machine where he withdrew the amount for the fine. Having paid it, he was then denied entry to the US, based on his admission of possession of the substance. The fact that the individual was escorted by Customs to get the money was 'widely mischaracterized', according to the US Ambassador, as involving forcible detention (United States Information Service. (1998) Letter from the US Ambassador to the Canadian Minister of Foreign Affairs). Such incidents are rare, but point to the need for exact procedures at preclearance sites allowing for the appropriate application of each country's laws.

ensure that travellers were apprised of their rights and obligations before entering the preclearance area.[21]

The Charter right to counsel by a person being detained was a key aspect, but the exclusion of non-travellers from the preclearance area was a potential conflict with this right. CBA recommended that the legislation allow for counsel access to the area (which is currently not allowed by US Customs), or eliminate all search, seizure and detention powers of preclearance officers. CBA went on to characterize the removal of the passenger's right to withdraw from the area as *de facto* detention. Under Canadian law, persons may not be detained on suspicion alone. The official must have "an actual belief based on reasonable and probable grounds that can be objectively reviewed".[22] Otherwise, since entry into the preclearance area is a voluntary activity, travellers should have a right to change their minds.

CBA thought that Section 16 should be scrapped altogether. This section required that the passenger be truthful with the preclearance officer. The intention of the provision was that if the US officer suspected or had evidence that the passenger made an untruthful statement, this would constitute, in itself, grounds for detention until a Canadian police officer could be called to assist. Section 33 (as originally submitted) makes it a summary or indictable offence under Canadian law to make a deceptive statement to a preclearance officer, and Section 34 makes it an offense to 'obstruct' such an officer. The Bar Association found the creation of a specific offense to be inappropriate and unnecessary, given the other remedies available under US law, such as monetary penalties and refusal of entry. More importantly, it created legal liabilities for anyone who 'participates in or assents to' such a false declaration, whether or not they were even present when the alleged deception occurred. These sections were regarded as "fundamentally flawed".[23]

The enforcement powers bestowed on the preclearance officers in Sections 19-24 were greater than those allowed to Canadian peace officers and could be exercised in an area where there was no access to US legal safeguards and where access to Charter rights was problematic. CBA suggested that the power to deny entry or impose monetary penalties, coupled with the ability of US enforcement officers to intercept a person after they had crossed into US territory were sufficient powers to accomplish their functions.

The forfeiture provisions posed problems both in Canadian law and, possibly, under US law. The issue is that, while there were access issues with respect to the Charter, the forfeiture would take place under Canadian law and on Canadian soil. Unlike the US Bill of Rights, property rights are not enshrined in the Charter, and it is questionable whether

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[21] CBA (1999), p 7.

[22] Ibid., p. 8. CBA later points out, however, that in the context of the [Canadian] *Customs Act*, the suspicion of an officer that there are reasonable grounds to believe concealment of illegal goods is sufficient to justify a search (p.12 cites R. v. Jacques, [1996] 3 S.C.R. 312 to establish that the degree of personal privacy that may be expected at borders is lower than most situations, and that "national self-protection is a compelling component in the calculus").

[23] Ibid. pp. 16-18.

a traveller would be able to seek US remedies. Even so, the cost of hiring a US attorney to prosecute a case in Canada might be prohibitively high.[24]

Changes in the Senate

The Senate was clearly concerned with the legality of requiring travellers to truthfully answer any question put to them by preclearance officers, and by the "detention" implied by the inability to leave the area. The bill was amended to indicate that a traveller had a right not to answer questions put to them for preclearance purposes,[25] but allowed the preclearance officer to order the person to leave the area if they would not answer. This order would be enforced by a Canadian officer, if necessary. It further stipulated that the refusal to answer a question was not, in itself, grounds for a search.[26]

Presumably, the Senate reasoned that the right to leave the area was sufficient to address the issue of the Charter right to counsel. If the person could withdraw from the area without prejudice, and return having sought counsel, the Charter was not derogated beyond reason. How this would take place in the "sterile" intransit area was not elaborated upon.

The issues of "assent to" and "participation in" false statements were also addressed. These references were removed from the legislation, so that only a person making actual statements they know to be false is engaging in illegal activity. The maximum sanction for such statements was reduced from an indictable offense with a potential for two years in prison to a summary offense, for which the maximum penalty is $5000. In this instance, prison cannot be imposed for default of the fine, and the false declaration does not constitute an offence for the purposes of the Criminal Records Act.

On the issue of reciprocity raised by CBA, the Senators appear to have been somewhat less concerned. They had heard testimony from DFAIT to the effect that the US had a mechanism to make reciprocal arrangements for equivalent powers as it was granted by the foreign state.[27] In any event, in its testimony before the Senate, CBA had indicated that the clarification of the various preclearance issues and the economic importance of

[24] Ibid., p. 16-17

[25] The phrase 'for preclearance purposes' is important. The CBA had been much concerned that the questions involved should be of a material nature (Proceedings of the Standing Senate Committee on Foreign Affairs Issue 30 – Evidence, p. 7).

[26] Journals of the Senate, Issue 124, Wednesday, March 24, 1999.

[27] Proceedings of the Standing Senate Committee on Foreign Affairs Issue 28 – Evidence, pp. 10-11. Mr. Preston was presumably referring to the power of the US Attorney General to authorize preclearance facilities in the United States. Foreign officers may be authorized to "exercise such authority and perform such duties as United States immigration officers are authorized to exercise and perform in that foreign country under reciprocal agreement, and they shall enjoy such reasonable privileges and immunities necessary for the performance of their duties as the government of their country extends to United States immigration officers" (USC8 Ch. 12. Immigration and Nationality Act, Subchapter I, Sec. 1103, parts (8) and (9) Powers and duties - Powers and Duties of the Attorney General and the Commissioner).

the bill were such that the issue of symmetrically should not impede passage of a bill, provided it did not derogate Charter rights.[28]

The Senate also discussed the issue of language rights. Under the Charter section 16, French and English are official languages. There did not seem to be any problem with US Customs equal treatment of French-speaking persons at its current operations, but there was agreement that some mechanism to ensure this was necessary, even if it involved airline personnel acting as interpreters.

The issue of privacy and use of information was of some concern, and DFAIT explained that US Customs destroys the information it collects after 24 hours under US law. The sorts of information that Customs wanted related largely to the history of the booking and pick-up of tickets, and the routings taken by a passenger.[29] Certain patterns tended to be consistent with travel patterns of drug smuggling operations.

Conclusions

The passage of the Preclearance Act will enable Canadian air carriers to compete effectively for international business and Canadian hubs to compete with US airports on a more even footing. This benefits consumers by allowing additional competitive opportunities for both established and new-entrant carriers in the Asia-Pacific and North Atlantic markets. The demonstration of intransit preclearance at Vancouver International proved the provided useful experience in organizing the preclearance area and validated the business case.

The Canadian Senate approved a more restricted set of precelarance procedures than had been sought by US Customs. Nonetheless, it does deliver the basic powers necessary to interdict illegal activity on the US-Canada border, while remaining consistent with the unfettered operation of the Charter of Rights and Freedoms on Canadian soil. It also clarifies and updates an arrangement that has worked very well for nearly a half a century of transborder air travel.

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[28] Proceedings of the Standing Senate Committee on Foreign Affairs, Issue 30, pp. 8-10.
[29] The Canadian standard for privacy applicable to government use of information is restricted in a number of ways. For example, the Department of Justice, in its Annotated Privacy Act, cites *Puccini v. Canada (Director General, Corporate Administrative Services, Agriculture Canada)*, [1993(3 F.C. 557 (T.D.), commenting "In *obiter*, the Court stated that when information is used to make a decision which will directly affect an individual, that individual has the right to know the gist of the information which the person considered or is considering in reaching the decision."

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Judging a Book by it's Cover: The relationship between service and safety quality in U.S. national and regional airlines

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Judging a Book by it's Cover: The relationship between service and safety quality in U.S. national and regional airlines

ABSTRACT

The general public perception is that service quality among U.S. airlines has declined significantly since deregulation, however, there is continuing debate among experts on the effect of deregulation on safety quality. Unlike safety quality, service quality is more visible to the traveling public. It is not clear, however, whether service quality is a good indicator of safety quality. We addressed this issue by examining the service and safety quality of 20 U.S. regional carriers for 1991-1997. Service and safety rates were calculated for each carrier. Then carriers were ranked on service and safety quality. Spearman's rho correlations were calculated on these lists. The results indicate that for four of these seven years the Spearman's rho was significant indicating that service quality is an excellent indicator of overall safety quality among U.S. national and regional carriers.

In it 's 1996 Strategic Plan, the Federal Aviation Administration (FAA) called ValuJet a model start-up airline that proved that the U.S. policy of deregulation was sound and workable (Schiavo, 1997). On May 11, 1996, ValuJet Flight 592 crashed into the Florida Everglades killing 105 passengers and 5 crew members. Prior to June 17, 1996 when the FAA announced the shutdown of Valujet, they continued to insist that the carrier was safe. In fact, the FAA has long insisted that all U.S. carriers were equally safe. However, in the Fall of 1996, Thomas McSweeny, FAA Director of Aircraft Certification, made a point of noting that the FAA is responsible only for the basic evaluation of airlines who are expected to police, evaluate, report, and improve themselves (Schiavo, 1997). The FAA which is responsible for establishing minimum safety standards and evaluating airline compliance has consistently refused to rank airlines or determine which carriers, if any, exceed minimum standards (Nader & Smith, 1994; Schiavo, 1997; Tampa Tribune, 1998). Critics have charged that the FAA has allowed its mission to promote air travel to take precedence over its responsibility to create a regulatory environment that promotes safety (Nader & Smith, 1994; Schiavo, 1997; Roy, 1998). In fact, one of the chief questions posed by a recently commissioned FAA study into the possible public release of safety information such as inspection and maintenance records was "Would the routine release of such information increase or decrease public confidence in the safety of air transportation?" (Roy, 1998).

According to the General Accounting Office (GAO), there are four main factors that affect the safe operation of airlines - (1) financial stability, (2) maintenance quality,

(3) management attitude, and (4) pilot competence (GAO, 1988, 1996). Unfortunately, none of these factors are readily apparent to the general traveling public. However, the traveling public is in a much better position to judge the service quality of the airlines they fly. This raises the question of whether there is a link between the service and safety quality of air carriers. Unlike safety, there are no minimum, federally-mandated standards for service quality. Presumably, the market is the sole determinant of the level of service quality that a carrier will provide. Since airlines are in some sense free to choose the level of service quality that they provide, it is clearly possible for a carrier to provide high levels of safety quality without also providing a similar level of service quality. On the other hand, we might expect that managerial (and employee) attitudes toward safety quality would be reflected in the level of service quality and that the financial condition of the carriers would have an impact on both areas of quality.

The purpose of this study was to investigate the link between service and safety quality. We sought to answer three questions. First, what is the level of service and safety quality for U.S. national and regional carriers? Second, what is the relationship between service and safety quality in these carriers? Third, can service quality levels be used as proxy measure of national/regional carrier safety quality?

BACKGROUND

In 1978, the U.S. became the first nation in the world to deregulate it's airline industry. Proponents of deregulation argued that regulation forced carriers to accept

uneconomical load factors on many long-haul flights, prevented the establishment of economies of scale, and created fares on regulated routes that were in many cases 50 percent higher than unregulated intrastate routes (Caves, 1962; Jordon, 1970). According to the contestable market theory (see Baumol, Panzar, & Willig, 1982 for further discussion), governments should seek to promote contests for markets, even those where large firm size and limited competitors existed. Regulation was said to encourage competition based on service quality rather than price, limit operational flexibility, and create no incentives for improved efficiency and productivity. Critics of deregulation have suggested that government policy now focuses almost solely on creating cheap, below-cost air fares and has resulted in destructive price wars (Dempsey & Goetz, 1992; Woerth, 1995).

The response of the airline industry to deregulation has been a long, painful process of restructuring that has changed the face of U.S. aviation. Financial crisis in the early 1980s led to industry consolidation and the creation of the hub-and-spoke system, actions which, in effect, eliminated sources of competition. In the early 1990s an industry-wide loss of nearly $10 billion dollars saw airlines develop complex holding structures, expand non-airline and/or discrete services, and race to create seamless global service networks, primarily through strategic alliances (Rosen, 1995).

Some of the results of this turmoil are clear. According to a recently published study on the cost competitiveness of international carriers, the major U.S. airlines (revenues over $1 billion) as a whole are more cost competitive than all but some of the

lower wage Asian carriers (Oum & Yu, 1998). The major airlines share of passengers at U.S. hub airports has also increased from 55 percent in 1985 to 79 percent in 1998 (DeBarros, 1998). At the same time, traffic along the spokes has been increasingly carried by regional airlines (gross revenues less than $100 million) whose smaller aircraft and lower cost structure presumably make these low volume routes profitable. In fact in 1998, there are 718 U.S. airports served by regional/commuter carriers as compared to only 216 served by major or national carriers (AvStat, 1998). Finally, although the number of airlines operating in the U.S. has increased from 43 to 90 since deregulation, more than two hundred new-entrant carriers have come and gone as a result of bankruptcy and merger (Rosen, 1995; Shifrin, 1998). Unfortunately, these results do not speak to changes in either service or safety quality following deregulation. Here there is far less agreement.

Service Quality

Antidotal evidence suggests that the overall level of service quality among U.S. carriers has declined significantly since deregulation, however, there are no studies actually examining the pre- and post-deregulation levels of service quality. Issues of airline quality have primarily been addressed through surveys conducted on frequent business flyers by such organizations as J.D. Powers and Associates. J.D. Powers and Associates has worked with Frequent Flyer magazine for the past six years to publish their quality survey of the major U.S. airlines. The survey provides an overall ranking as well as individual "bests" for such categories as ease of check-in, seat comfort, gate location, and post-flight services. However, these cross-sectional results are difficult to

duplicate and compare.

In 1991, the Airline Quality Rating (AQR) system developed by the Institute of Aviation Research at Wichita State University began its annual review of airline quality. Unlike other quality rankings, the AQR uses published, publicly available data to construct a multi-factor weighted average of airline quality for the major U.S. carriers. This system includes data on airline safety, financial stability, and consumer complaints. Much of the data is collected from the Air Travel Consumer Report published quarterly by the Department of Transportation (DOT). This method has several advantages. First, it provides a consistent, longitudinal measure of airline quality. Second, its results can be replicated. However, it should be noted that the AQR, which has reported a negative industry average level of quality for all six years of its existence, has been criticized on a number of counts. Airlines have complained about the weighting scheme which, for example, assigns a negative weight to airline load factor (the percentage of available seats that are filled by paying passengers). A second criticism relates to the nature of the complaints included in the AQR. By and large, the factors contained in the Air Travel Consumer Report, and included in the AQR, relate to the provision of basic service (i.e. on-time percentage, flight problems, denied boardings, customer service, refunds, fare complaints, etc) not amenities such as seat comfort, ease of check-in, schedule availability, or meal quality. This not only makes a direct comparison between the AQR and the survey quality ratings difficult, it has led to criticism that the AQR does not accurately reflect factors consumers consider important to their satisfaction (Perkins, 1998). There is another difference between the AQR and the survey studies. The AQR

includes safety related measures –average age of fleet, number of accidents, and pilot deviations - while survey methods typically do not consider safety issues.

It should be noted that neither the airline quality surveys nor the AQR have addressed the issue of service or safety quality for the national or regional U.S. carriers. Like any research dealing with small businesses, there are problems relating to data availability that can be attributed to at least two factors. The first is timely reporting by smaller firms. The second is the turnover in this type of population. However, two recent studies have compared service quality between major and national/regional carriers in the U.S. as well as between the individual national/regional carriers themselves. Both studies used the complaint data from the Air Travel Consumer Report to conclude that there is a substantial difference in the service quality of major and national/regional carriers. For example, Rhoades, Waguespack, and Treudt (1998) have reported that U.S. major carriers averaged 6 complaints per 10,000 departures in 1996 while U.S. national/regional carriers averaged 3 complaints per 1,000 departures. There was also substantial variation between national/regional carriers. Two national/regional carriers posted 1996 complaint rates lower than the major carriers while several other national/regional carriers had rates far higher than the industry average for this group. In a second study, Rhoades and Waguespack (1999a) concluded that there were statistically significant differences between the level of service quality among national/regional carriers.

Safety Quality

While there has been little debate about the effect of deregulation on service quality, its effect on safety quality has been hotly debated. Two studies have examined pre- and post-deregulation accident rates. Both studies have reported a substantial decline in the overall accident rate (Barnett & Higgins, 1989; Rose 1989,1990). Oster and Zorn (1989) addressed the possible reasons for the decline by reviewing the primary cause of pre- and post-deregulation accidents. They reported an overall decline of 54 percent in total accidents per million departures, with a 71 percent reduction in accidents initiated by equipment failure. However, it is not clear, for example, whether the decline in equipment failure is due to improved equipment reliability and design, maintenance quality or both. Kennet (1990) has found that although the length of time between engine maintenance has increased since deregulation there has been no effect on engine failure. This would suggest that equipment design is largely responsible for the decline in accidents attributed to equipment failure. If equipment design and reliability have improved, then the fact that the U.S. fleet is aging raises some concern. In 1988, only 28 percent of the U.S. fleet were over 20 years old. By 2000, 40 percent of the fleet is projected to be over 20 years old (Schiavo, 1997). The average age of the fleet flown by regional carriers tends to be even older than their major carrier counterparts (Wilson, 1997). In addition, after sharp declines in accident rates during the 1950s and 1960s attributable to improved jet engine reliability, the accident rate has leveled off in recent years at approximately 3 to 4 percent annually (Booz, Allen & Hamilton, 1996). Several studies have also reported a recent increase in the rate of accidents which may reflect either normal variation in accident rates, lagged effects of reduced maintenance, or some

other cause (Rose, 1990; 1992).

Research into airline safety has focused on four areas of concern: financial stability, maintenance quality, pilot competence, and management attitude (GAO, 1988)

Financial Stability. A number of researchers have argued that safety expenditures are an investment because they yield returns over time and that it is plausible that unprofitable or insolvent airlines would reduce their level of investment in maintenance and safety (Graham & Bowes, 1979; Lee, 1996). It is also possible that financial issues might cause carriers to defer maintenance expenditures either due to the direct cost of such maintenance or the need to keep the aircraft in-service (Roland, 1997). Carriers can invest in safety by 1) scheduling maintenance more frequently, 2) using newer equipment to reduce the probability of equipment failure, 3) relying on more experienced personnel, 4) implementing more intensive training programs, and 5) purchasing newer aircraft that have more advanced safety technology (Rose, 1990). In short, Lee (1996) has suggested that aviation safety is a direct function of the amount of money spent.

Rose (1990, 1992) has reported that lower operating profit margins are associated with higher accident and incident rates in the following year. This relationship is even stronger for regional carriers than their major carrier counterparts. There are several possible explanations for these results. First, regional carriers tend to outsource a great deal of their maintenance because their fleet size often does not make it economical to

invest in the equipment necessary to service their own aircraft. This outsourcing may create certain quality problems. Second, the average age of the aircraft flown by regional carriers is substantially older than most major carriers (Wilson, 1997). Third, the experience level (and pay levels) of regional flight crews is generally lower than major carriers (Aviation Week & Space Technology, 1999). Finally, the average lifespan of most regional carriers may not permit them to institutionalize the practice of safety (Kanafani & Keeler, 1989).

Not all researchers agree that regional or new entrant carriers have lower safety performance. Kanafani and Keeler (1989) found no difference in safety levels and, in fact, reported that new entrants appear to be spending more resources on maintenance than the large established carriers. Whether this higher spending is a consequence the age of their fleet or attributable to higher safety standards was not addressed.

Maintenance quality. The most commonly used measure of maintenance quality has been the level of maintenance expense. Several factors that can increase the level of maintenance expenditure are the age of the aircraft in the carriers fleet, the type and mix of aircraft in the fleet, and the level of maintenance outsourcing (GAO 1988; O Toole, 1992). While smaller carriers have not previously been required to report their maintenance costs, the General Accounting Office has reported that carriers who spent more on maintenance between 1955 and 1983 actually had a higher accident rate than other airlines. One explanation for this result is the fact that older aircraft have higher maintenance costs and are more likely to be involved in accidents.

Pilot Competence. The FAA (1995) has reported that 60-80 percent of all airplane accidents are caused by human error. While air traffic control accounts for some of these errors, it is the flight crew that is responsible for the majority of accidents attributable to human error (GAO, 1988). Pilot competence is a function of training, experience, capability, and attitude. Although airlines are required to maintain FAA approved training programs, the GAO (1988) has found that there is wide variation in training methods. Compared to major carriers, the experience level (and pay levels) of regional carriers is generally much lower. The most recent survey by Aviation Week and Space Technology reported that national/regional pilots can expect to make on average one-half to one-third the salary of their major carrier counterparts (Aviation Week & Space Technology, 1999). Still, it remains difficult to assess the competence of pilots and difficult to link flight experience to accident rate (GAO, 1988).

Management attitude. The attitude of airline managers toward safety has been cited in numerous studies as an important factor in assessing the overall safety of an airline (Banfe, 1992; GAO, 1988; Lee, 1996). According to Lee (1996), it is also clearly possible for an unsafe company to increase its operational safety for minimal costs by improving organizational factors such as communications and personnel selection and local factors such as workplace safety consciousness. ' Banfe (1992) has found that the intellegence of an organizations structure and its management are key factors in firm success. Unfortunately, experts agree that management attitude is judgmental and subjective making it difficult to quantify.

Linking Service and Safety Quality

It is perhaps this difficult to quantify "management attitude" that provides the link between service and safety quality. Studies of Total Quality Management and ISO 9000 quality programs consistently cite the presence of a "quality culture" and top management support as critical to the success of any quality program (Deming, 1982; Koo, Koo, & Tao, 1998; Mallak, Bringelson, & Lyth, 1997). These attitudes are expected to permeate the organization and affect everything that it does. Our question was "Can organizations create a quality culture that extends to only some aspects of their operation and not to others?" Is it possible for a carrier to be rated highly on safety quality and not on service quality?

METHOD

This study included data on 20 U.S. regional carriers in operation between 1991 and 1997. For our purposes, a national/regional carrier is defined as one having operating revenues less than $1 billion. Of these carriers, twelve were not in operation for the entire period. Some carriers started operation during this period (ex. Vanguard, Kiwi, Western Pacific). Other carriers were either acquired (Ex. Carnival, ValuJet) or ceased scheduled operation (ex. Kiwi, Western Pacific). Data for this study was collected from three sources. The Department of Transportation's Air Travel Consumer Report was the source for consumer complaints. It includes the following categories: ticketing, refund, fare, advertising, customer service, credit, and other. Unfortunately, carriers with less than 10 total complaints are not reported separately but included in an "other U.S.

airlines" category. Since it was not possible to determine the actual number of complaints for carriers in this last category, it was treated as a missing value. The FAAs online safety databases were used to collect information on accidents, incidents, and near mid-air collisions. Data on pilot deviations was collected directly from the FAAs Office of System Safety. Total departures per year were collected from the Bureau of Transportation Statistics.

Service and safety rates were calculated overall and by year for all carriers. The service quality rate represents the sum of all complaints divided by total yearly departures and can be interpreted as the number of quality problems per departure - i.e. a service quality rate of 0.005325 would translate into 5 service quality problems per 1000 departures. The safety quality rate represents the sum of all accidents, incidents, near mid-air collisions, and pilot deviations divided by total yearly departures and can be interpreted in a manner similar to the service quality rate. Correlations were calculated between service and safety averages for each carrier and each year of the study. Since both rates were divided by departures, we treated the averages as matched pairs and compared the means by year and carrier using the paired t-test. Because paired t-test calculations with fewer than four observations proved to be unstable, carriers with less than four observations were not included. Finally, the carriers were ranked by year and overall means for both service and safety quality. These ranked list were then compared using the Spearman 's rho correlation. If each carriers safety rank is identical to their service rank, then the Spearman 's rho would yield a perfect 1.0. We would then conclude that service quality provides consumers with an excellent proxy of carrier safety

quality. The lower the Spearman's rho, the greater the difference between the service and safety quality of regional carriers and the less validity service quality has as a measure of safety quality.

RESULTS

Tables 1 and 2 report the calculated service and safety quality rates respectively. For all years of the study, the safety rate is lower (better) than the service rate. When these safety rates are compared to those reported by Rhoades and Waguespack (1999), national/regional carriers do not perform as well as their U.S. major counterparts. For example, the overall safety rate for national/regional carriers was two safety problems per 10,000 departures while the overall safety rate for major carriers was eight problems per 100,000. Table 3 reports the correlations and results of the paired t-test by year

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Insert Table 1 & 2 about here

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and overall for the national/regional carriers. For all but three years of the study, the correlation between the average service and safety quality rate was significant. The difference between the service and safety means was significant only for one year (1996). Thus, we conclude that there is no statistical difference between the service and safety quality means for the remaining years. The difference between the overall service and safety mean was also significant.

Insert Table 3 about here

Table 4 presents the number of observations, correlations, and t-values by carrier for all carriers with three or more reported yearly values. Four carriers (Air South, Alaska, Reno Air, and Tower) recorded a negative correlation between service and safety quality. The t-value was statistically significant for five carriers (Alaska, Carnival, Comair, Hawaiian, and Tower) indicating that their mean levels of service and safety quality are statistically different. Table 5 reports the number of yearly observations and the results of the Spearman's rho test. The Spearman's rho was statistically significant

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Insert Table 5 about here

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for the years 1994-1997. The overall Spearman's rho was also significant. The Spearman's rho test indicates that for these years there is a statistically significant, strong correlation between the service quality ranking of U.S. national/regional carriers and their safety quality ranking.

Discussion

We began this study by asking whether U.S. air travelers could use their impression of the service quality of the national/regional carriers they fly to judge the safety quality of those same carriers. The answer is yes. For those years where we

obtained data on twelve or more carriers, there is a strong, statistically significant relationship between the service and safety quality rankings of national and regional carriers. While the relationship is not a perfect one, we did not obtain a Spearman's rho below .54 while the highest value was .87. We had argued that 'quality' is an attitude that should permeate organizations affecting all aspects of their operation. In the case of national/regional carriers this appears to be true.

These results, however, contrast sharply with a similar study comparing the service and safety quality of major U.S. carriers. Rhoades and Waguespack (1999b) have reported that they found no statistically significant relationship between the service and safety rankings for the nine major U.S. carriers in their study. What accounts for this difference in findings? Several factors may individually or collectively contribute to the observed differences. First, the major carriers as a group tend to be more homogeneous in terms of their service and safety quality than regional carriers. According to Rhoades and Waguespack (1999b), as a group, major carriers also have service and safety rates well above the industry average for the national/regional carriers calculated in this study (ex. Overall major service rate for 1991-1997 was 7 problems per 10,000 departures as compared to 3 per 1,000 for national/regional carriers. Overall, safety rate for the majors was 8 problems per 100,000 departures compared to 2 problems per10,000 for national/regional carriers). Second, the average lifespan of the major carriers is far higher than their national/regional counterparts. This has potentially allowed them more time to institutionalize safety/service practices. Third, by their very nature regional carriers do not compete directly with many of their so-called regional counterparts while

the major U.S. carriers do compete in virtually all their rivals markets. This competition could encourage the major carriers to either differentiate themselves by offering a higher level of service than similar carriers in the target market or adopt the same level of service offered by other market competitors. In some sense, national/regional carriers have no comparable strategic group member to benchmark their performance. Finally, in order to operate carriers must meet minimum safety levels, but no such levels exist for service quality. New entrant carriers are more likely to focus on safety quality first and hope that passengers lured by cheap fares will accept lower levels of service quality.

This study is not without its limitations. The complaints gathered from the Air Travel Consumers Report deal primarily with issues of basic service, that is the ability to issues tickets and refunds correctly and in a timely manner, to avoid flight problems and overbooking, and to deal honestly and politely with consumers in advertising, marketing, and flight operations. Although there is a category for other complaints, the Report does not specifically address areas of quality such as meals, seat comfort, and in-flight entertainment. However, in the case of national/regional carriers, this emphasis on basic service issues is probably more appropriate. Regional carriers as a general rule seek to compete by trading off amenities for lower fares. Many such carriers offer no-frill, single-class service.

There are also several questions that might be raised over the calculation of our safety rates. We chose to treat accidents, incidents, near midair collisions, and pilot deviations as equal safety events. Obviously, from a passenger perspective an accident

would be rated far worse than a pilot deviation, however, it is not clear to the authors that an accident is a better indicator of the overall level of airline safety than a pilot deviation or incident. Accidents are fortunately rare occurrences and often the result of multiple factors. In the absence of compelling evidence of the relationship between the four types of safety events used in this study, we opted for the equal weighting.

There are a number of practical implications to be drawn from this research for managers as well as passengers. Service quality matters not simply because it sells tickets. It is part of a total quality attitude that has the potential to affect all aspects of airline operation. Providing basic, timely, consistent service requires the same attention to detail that maintenance and flight operations do. It is a matter of process development, training, implementation, tracking, and continuous improvement. If a carrier can institutionalize a quality process for safe operations, then they have the tools and skills to do the same thing with the service side of their operation. Achieving service quality does not necessarily require carriers to hire gourmet chefs to design their meals. A great meal does not make up for an overbooked flight, lost bag, or deceptive advertising.

There are several future avenues of research that extend this study. The first is an examination of the relationship between service/safety quality and financial performance. A second area of research would be to focus on factors that might either encourage or discourage the development of quality processes in regional carriers such as organizational age, competition, financial stability, and managerial expertise.

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Table 1

Service Quality Rate for Regional Airlines

Airline	1991	1992	1993	1994	1995	1996	1997	Avg. TC
Air South					0.001013	0.003916	0.012777	0.005902
AirTrans				0.002972	0.000585	0.001493		0.004054
Alaska	0.000143	0.000162	0.000116	0.000254	0.000263	0.000304	0.000377	0.000231
Atlantic SE				0.000039	0.000058	0.000223	0.000184	0.000126
Business Express		0.000046	0.000046	0.000170	0.000026	0.000567		0.000214
Carnival	0.003181	0.001596	0.002222	0.002440	0.002485	0.010379		0.006238
Comair		0.000095	0.000087	0.000060	0.000067	0.000076	0.000100	0.000081
Eastwind							0.002860	0.002860
Frontier						0.000717	0.000657	0.000687
Hawaiian	0.000785	0.000816	0.000601	0.000430	0.000401	0.000505	0.000662	0.000600
Horizon						0.000043	0.000100	0.000072
Kiwi				0.000601	0.000738	0.005185	0.010875	0.004350
Markair			0.001335	0.001012	0.018110	0.010665		0.009929
Mesa						0.000112		0.000112
Midway				0.001350	0.000494	0.001898	0.000740	0.001121
Midwest								
Reno				0.000210	0.000367	0.000408	0.000690	0.000419
Tower	0.005930	0.006793	0.009434	0.019899	0.008720	0.013593	0.024466	0.012691
Valujet				0.000545	0.001014	0.003029		0.002568
Vanguard						0.002485	0.003938	0.003212
Western Pacific						0.000991		0.000991
Industry Avg	0.002510	0.001585	0.001977	0.002316	0.002453	0.003158	0.004494	0.002823

Table 2

Safety Quality Rate for Regional Airlines

Airline	1991	1992	1993	1994	1995	1996	1997	Avg. SR
Air South					0.000145	0.000385	0.000211	0.000247
AirTrans				0.005944	0.000146	0.000299		0.002130
Alaska	0.000125	0.000119	0.000045	0.000082	0.000090	0.000045	0.000063	0.000081
Atlantic SE			0.000049	0.000024	0.000009	0.000021	0.000032	0.000025
Business Ex	0.000183	0.000108	0.000075	0.000089	0.000026	0.000378		0.000143
Carnival	0.000245	0.000199	0.000089	0.000193	0.000166	0.000256		0.000191
Comair		0.000088	0.000080	0.000048	0.000061	0.000036	0.000049	0.000060
Eastwind							0.000000	0.000000
Frontier						0.000055	0.000141	0.000098
Hawaiian	0.000080	0.000102	0.000109	0.000036		0.000067	0.000060	0.000076
Horizon						0.000052	0.000043	0.000048
Kiwi				0.000300	0.000046	0.000232	0.000253	0.000208
Markair			0.000072	0.000112	0.000150			0.000111
Mesa						0.000035	0.000086	0.000061
Midway						0.000035	0.000082	0.000059
Midwest	0.000088	0.000045	0.000039	0.000067	0.000089	0.000140	0.000130	0.000085
Reno			0.000038	0.000139	0.000061	0.000049	0.000077	0.000073
Tower	0.000423	0.000358	0.001347	0.000195	0.000748	0.000197	0.000239	0.000501
Valujet				0.000204	0.000206	0.000125		0.000178
Vanguard					0.000085	0.000121	0.000114	0.000107
WestPac						0.000045		0.000045
Industry Avg	0.000191	0.000146	0.000194	0.000572	0.000144	0.000135	0.000079	0.000226

Table 3

Correlations and Results of Paired t-test by Year

Year	N	r	Paired t-test
1991	4	0.97**	1.849
1992	6	0.97***	1.383
1993	7	0.97***	1.557
1994	12	0.05	1.065
1995	12	0.43	1.716
1996	18	0.43	2.760*
1997	12	0.86***	2.069
Overall	19	0.27	3.187**

*p<.05 **p<.01 ***p<.00

Table 4

Correlations and Paired t-test by Airline

Airline	N	r	Paired t-test
Air South	3	-0.02	1.597
Alaska	7	-0.39	3.552**
Atlantic SE	4	0.46	2.395
Business Express	5	0.97**	0.795
Carnival	6	0.57	2.642*
Comair	6	0.42	2.538*
Hawaiian	6	0.63	9.985***
Kiwi	4	0.34	1.724
Reno Air	4	-0.49	3.033
Tower	6	-0.45	4.450**

Table 5

Spearman's rho of Ranked Results by Year

Year	N	Spearman's rho
1991	4	0.800
1992	6	0.714
1993	7	0.536
1994	13	0.748**
1995	14	0.848**
1996	19	0.650**
1997	12	0.872**
Overall	19	0.742**

*p<.05 **p<.01 ***p<.00

Determinants of Price Reactions to Entry in the US Airline Industry

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1. Introduction

> Unfortunately, the expected bear hug by the major airlines has begun … Three of the [major airlines] are now offering fares in AccessAir markets that are one-third below our fares – and far below both their normal fares and their costs. If continued, these fares will force us out of business.[1]

> The notion that our actions were anticompetitive just doesn't pass the giggle test[2]

The reactions of established air carriers to new entry has been a contentious issue in the United States over the past several years. They are a focus of proposed US Department of Transportation guidelines that would restrict "exclusionary" or predatory practices by air carriers, a Justice Department antitrust suit against American Airlines, and a study by the National Academy of Science's Transportation Research Board into competitive practices in the US airline industry, instituted at the behest of Congress.[3] The crux of the issue is whether the responses by established carriers to new entry onto routes are normal competitive reactions or predatory reactions designed to drive the new carriers out of markets.

There have been a number of studies conducted into the issue of predation in the airline industry. These studies have reached differing conclusions. For example, using Canadian data, Tomaszewska (1997) concluded that there was evidence of predation over a two year period in a major Canadian market. On the other hand, Dresner and Windle (1999), in their broad study of US air markets, found little evidence of any practices by major incumbent carriers against smaller new entrants that could be deemed predatory.

[1] Roger Ferguson, the president of start-up air carrier AccessAir, quoted in Swoboda (1999a).
[2] American Airlines spokesman Chris Chiames, quoted in Swoboda (1999b).
[3] See: U.S. Department of Transportation (1998), Swoboda (1999b), and Transportation Research Board (1999).

This paper takes a different approach to the examination of competitive reactions. In this paper, we determine the entrant characteristics and strategies, incumbent characteristics, and market characteristics that govern incumbent carrier reactions. Using data on 981 reactions to entry by incumbent carriers, we assess the impact of these carrier and market specific factors on incumbent price responses following entry both in the short run and the longer run. The results from the analysis can be used to help predict the likely reactions to entry by incumbent carriers, and are therefore useful to airline managers. The results are also useful to policymakers since they describe the market and firm characteristics that are most likely to lead to large price cuts by incumbents, be they termed predatory or just competitive.

The rest of the paper is structured as follows: Section 2 provides a brief review of the theoretical literature underlying our analysis and comments on the theoretical contribution of the paper. Section 3 presents our model and describes the data used in the analysis. Section 4 describes the results from the analysis. Finally, Section 5 draws conclusions and presents some implications to managers and policymakers.

2. Literature Review and Theoretical Contribution

The literature on competitive reactions and responses generally comes from three research sources: industrial organization economics (IO), strategy, and marketing. An important feature of the industrial organization literature (as outlined, for example, by Scherer and Ross (1990)) is its emphasis on the structure-conduct-performance paradigm.[4] The paradigm implies that a new entrant may have an important impact on

[4] The paradigm holds that performance depends upon the conduct of sellers and buyers (in such matters as pricing behavior, interfirm cooperation, product strategy and advertising, research and development).

market prices if it prices aggressively in order to stimulate demand for its products/services. In the airline industry, the aggressive pricing may trigger an aggressive response from incumbent carriers. Dresner and Windle (1999), using data from the U.S. domestic airline industry, found evidence confirming this hypothesis. The authors found that the largest price cuts by incumbents in response to entry came when entrants priced their services at deep discounts to prevailing prices. In other words, deep price cuts by new entrants triggered deep price discounts by incumbent competitors.

In contrast to the industrial organization literature, the strategy literature is concerned more directly with the actions and reactions (responses) used by each competitor. According to the strategy literature, the type of reactions used by rival firms (e.g., fight or retreat) depend on factors such as the action-firm's reputation (Smith, Grimm and Gannon 1992), the threat/scope/magnitude of actions (Smith, Grimm and Gannon, 1992; Smith, Grimm, Gannon and Chen 1991), the importance of a market to the firm (Chen and MacMillan, 1992; Chen and Miller, 1994), and the performance of firms (Smith, Grimm, Gannon and Chen, 1991; Smith, Grimm and Gannon 1992).

Empirical marketing research on incumbent reaction to entry is limited but tends to track closely the approaches used in the strategy literature. Robinson (1988) explained reactions (using a reaction index) as a function of the entrant's strategy, incumbent characteristics, and industry characteristics. Gatignon, Anderson and Helsen (1989) posited that interfirm differences in competitive reactions to entry can be predicted by

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Conduct, in turn, depends upon the structure of the relevant market (characterized by the number of competitors, product differentiation, barriers to entry, cost structure, vertical integration and diversification) while market structure is affected by a variety of basic conditions of supply and demand (such as price elasticity, growth rate, substitutes, technology and legal framework). Hence, the degree of rivalry among firms in an industry is, at least indirectly, a function of market structure.

observing the elasticity of each market mix variable; for example, competitors will retaliate with their effective marketing mix "weapons" and retreat with their ineffective marketing instruments.

As in the strategy and marketing literature, this paper takes into account entrant, incumbent, and market characteristics in assessing competitive reactions. However, the research for this paper improves on existing models in three areas. First, in much of the existing literature, many different kinds of actions/reactions - including price cuts, entry, advertising, the formation of alliances or mergers - are generalized into a generic "action/reaction" variable. Treating price cuts and alliance formation as equivalent actions may hide very different strategies employed by firms. In this research, we use a specific measure of price cuts to assess reactions to entry. Secondly, this paper more accurately measures the degree of an incumbent's responses than previous work. Much of the existing literature focuses on the direction of responses and response time. In this paper, we accurately measure the level of response (i.e., the magnitude of a price cut). Finally, most literature addresses only short-run reactions while ignoring longer-run reactions. In this paper, we examine both short and longer run reactions. This is important since firms may react vigorously (e.g., large price cuts) in the short run, only to retreat (e.g., by raising prices) in the longer run. The longer run reactions will provide a much better indication of long run equilibrium market conditions.

3. Model and Data

The general model used to analyze responses to entry on U.S. airline routes is as follows:

$$RESPONSE = f\,(ENTRY\ STRATEGY,\ ENTRANT\ FACTORS,\ INCUMBENT\ FACTORS,\ MARKET\ FACTORS) \quad (1)$$

where:

- Response to entry is either the short or long run price cut initiated by an incumbent carrier in response to the entry by a new carrier on a route;
- Entry Strategy is a vector of variables reflecting the strategy used by the new entrant including the pricing and capacity strategy of the new entrant;
- Entrant Factors is a vector of variables assessing the qualities of the entrant that might affect the response of the incumbent (e.g., financial strength of entrant);
- Incumbent Factors is a vector of variables related to the incumbent that might affect the incumbent's response (e.g., market position of the incumbent on the route); and,
- Market Factors is a vector of market or industry variables that might affect the incumbent's response (e.g., barriers to entry on a route).

Data were gathered from the Department of Transportation's Database 1a on all entries into the top 500 origin and destination markets (as of the second quarter of 1997) that took place from the third quarter of 1991 to the second quarter of 1997.[5] A total of 543 entries from 40 airlines were available for analysis.[6] Of this total, 151 entries were

[5] Database 1a excludes commuter carriers. Following Windle and Dresner (1995), entry had to meet a two part test. In the quarter before entry, a carrier had to have less than a five percent market share on a route. Secondly, entry had to increase the carrier's market share by at least five percentage points to a level above five percent of total passengers. Other definitions were considered (e.g., market share less than 10 percent increasing by at least 5 percentage points) but a review of the data indicated that these other definitions resulted in actual entries being missed or the number of entries being overestimated.

[6] There were a number of entries that were excluded before arriving at the 543 total. These included cases where the entrant's code was not known (30 cases) and seasonal routes where a carrier entered a route on a regular basis for a season and then exited (4 cases). As well, after examining the data, 70 cases that met

by major (i.e., pre-deregulation) carriers, 63 by Southwest Airlines, and 329 by 32 other smaller carriers. The overall exit rate (within a year of entry) for the new entrants was 17.3 percent; 27.8 percent for the majors, 0 percent for Southwest, and 15.8 percent for the smaller carriers.[7]

Data were also gathered on incumbent responses to each of the 543 entries. A carrier was considered an incumbent on a route if it had a minimum 10 percent market share prior to entry by another carrier and maintained at least a 10 percent market share in the quarter following entry.[8] As well, a maximum of 3 incumbents (the largest 3) were analyzed for each entry event. This criteria resulted in 981 incumbent observations; 730 from majors, 51 from Southwest, and 200 from other carriers.

Table 1 provides a list of variables for each of the constructs in our model as well as a description as to how the variables are operationalized. Each of the variables is discussed briefly below:

a) Response to Entry (Dependent Variable)

Short and Long Term Price Cuts by Incumbent: The dependent variable in each of our models is the incumbent's price cut (or increase) in response to entry. In the short run model, the price cut is measured as the average incumbent's price on a route in the quarter before entry less the incumbent's average price in the quarter following entry (i.e., $P^i_{Q-1} - P^i_{Q+1}$, where Q is the quarter of entry). In the longer run model, the average incumbent's price four quarters following entry is subtracted from the average price in

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our entry criteria were excluded because at a closer look, they appeared to be just market share fluctuations (e.g., market shares over successive quarters of 2%, 7%, 4%, 5%, 6%, 3%, etc.).

[7] The exit rate for the smaller carriers excludes 11 "exits" due to the takeover of Morris Air's routes by Southwest Airlines and 14 exits due to the grounding of ValuJet by the Department of Transportation. If these exits were counted, the exit rate for the smaller carriers would rise to 24.1 percent.

[8] If an incumbent exited from a route in the same quarter as entry, no data where available on that incumbent for analysis.

the quarter before entry (i.e., $P^i_{Q-1} - P^i_{Q+4}$). In either case, the larger the price cut, the more aggressive the reaction to entry.

b) Entry Strategy

Price Cut of Entrant: The average price cut of the entrant in the quarter after entry (i.e., $P^i_{Q-1} - P^e_{Q+1}$) is an independent variable in the model. All else held equal, it was thought the greater the entrant's price cut, the greater the incumbent's price cut.[9]

Scale of Entry: Entry scale was measured by the number of passengers carried by the entrant in the quarter following entry.[10] It was thought that a greater entry scale would trigger a larger price cut by the incumbent.[11]

Routing: We attempted to control for the quality of service offered by the new entrant by measuring the average number of flight segments on routes offered by the new entrant. In general, it was thought that fewer flight segments (e.g., more non-stop routings) offered by the new entrant would result in larger price cuts.

c) Entrant Factors

Operating Cost Structure of Entrant: One of the characteristics of the entrant that could affect the reaction of the incumbent is the entrant's cost structure (measured by operating cost per seat-mile in the calendar year before entry). An incumbent may be intimidated by a low cost entrant and respond passively (small price cut), thereby ceding market

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[9] The average price cut in the quarter following entry was used for both the short and longer run models. We considered using the average entrant's price cut *four* quarters following entry for the longer run model but would lose 24 percent of our observations if we did so. This is because 24 percent of the new entrants had exited their new routes by four quarters after entry, so price information was not available.

[10] An alternative measure would have been the number of seats offered by the entrant in the quarter following entry. Seat totals, however, were not available to the researchers.

[11] Note, that although we argue that greater entry scale will trigger a larger price cut by the incumbent, a case could be made for the opposite position; that is, large entrants will intimidate incumbents thereby triggering less aggressive responses (i.e., smaller price cuts). Since most of the "expectations" on coefficient signs can be argued either way, we do not present formal hypotheses. Rather, we state our

share, or, on the other hand, may try to deter the low cost carrier by responding aggressively with large price cuts.

Size of Entrant: The size of the entrant (measured by total revenues in the calendar year before entry) may also affect the reaction of the incumbent. Large entrants may, in many cases, have a large store of resources to withstand competitive battles. Therefore, incumbents may not choose to fight price wars with large entrants, therefore responding to entry with relatively small price cuts.

Reputation of Entrant: The reputation of an entrant (measured by number of complaints per 100,000 passengers registered with the Department of Transportation) may also influence incumbent response. In the case of an entrant with a good reputation among customers, an incumbent may have to respond with relatively larger price cuts (all else being equal) to compete against the entrant.

Ability to Remain on the Route: In the long run, the ability of a new entrant to remain on a route will affect the response of the incumbent. It was thought that if a new entrant failed to remain on a route (dummy variable coded 1), then the price cut of the incumbent would be smaller. In other words, if the entrant leaves the market, the incumbent may be able to raise prices to a level close to its pre-entry price.

d) Incumbent Factors

Operating Cost Structure of Incumbent, Size of Incumbent, Reputation of Incumbent: Data on these variables were collected for the incumbent, as well, with the arguments similar to those presented above. The lower the operating cost of the incumbent, the

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expectations based on our understanding of the industry and our reading of the literature knowing that valid arguments could often be made in the opposite direction.

greater its size, and the better its reputation, the smaller it was thought would be the price cut by the incumbent in response to entry.

Importance of Route to Incumbent: Data were gathered on the route market share of the incumbent in the quarter prior to entry. It was thought that all else held equal, that the greater the incumbent's market share (i.e., the more important the route to the incumbent), the larger its price cut following entry.

e) Market Factors

Barriers to Entry: It was thought that if barriers to entry existed on a route, then the magnitude of the price cut by the incumbent might be smaller. An important market barrier might be if either or both ends of a route are at slot controlled airports. Slot controls at a major airport (e.g., O'Hare in Chicago) could imply that new entrants have to offer service from a secondary airport (e.g., Midway in Chicago).[12] If the incumbent airline's service is primarily from the city's major airport, then it might not have to adjust prices to the same extent as it would if competition was from the major airport. As a result, a dummy variable for having a slot controlled airport at either end of a route was included.

Competitive Routings Available: Another market factor that could affect the incumbent's price cuts is if competitive routings are available. In this case, if there are alternate airports close to the airport entered, then the incumbent may not cut prices as much as it might otherwise. The incumbent may choose to switch flights to nearby airports, rather

[12] It should be noted that Database 1a records traffic for city to city routes, rather than airport to airport routes, but that city definitions are inconsistent. For example, Washington Reagan National and Washington Dulles traffic are lumped together as Washington traffic but Los Angeles International traffic is not lumped together with Long Beach or Orange County traffic.

than to cut prices and aggressively compete against the new entrant. Therefore, a dummy variable was included for cities with multiple airports.[13]

Based on the discussion above, Equations 2 and 3 present the short run and long run operational models to be estimated.

Incumbent's Short Run Price Cut ($P^i_{Q-1} - P^i_{Q+1}$) = $\beta_0 + \beta_1$ Entrant's Price Cut ($P^i_{Q-1} - P^e_{Q+1}$) + β_2 Entrant's Passengers $_{Q+1}$ + β_3 Entrant's Flight Segments + β_4 Entrant's Cost + β_5 Entrant's Revenues + β_6 Entrant's Complaints + β_7 Incumbent's Cost + β_8 Incumbent's Revenues + β_9 Incumbent's Complaints + β_{10} Incumbent's Market Share $_{Q-1}$ + β_{11} Slot-Controlled Airport + β_{12} Multiple Airport City (2)

Incumbent's Longer Run Price Cut ($P^iQ_{-1} - P^i_{Q+4}$) = $\beta_0 + \beta_1$ Entrant's Price Cut ($P^i_{Q-1} - P^e_{Q+1}$) + β_2 Entrant's Passengers $_{Q+1}$ + β_3 Entrant's Flight Segments + β_4 Entrant's Cost + β_5 Entrant's Revenues + β_6 Entrant's Complaints + β_7 Incumbent's Cost + β_8 Incumbent's Revenues + β_9 Incumbent's Complaints + β_{10} Incumbent's Market Share $_{Q-1}$ + β_{11} Slot-Controlled Airport + β_{12} Multiple Airport City + β_{13} **Entrant Failed on Route** (3)

The models vary only in their dependent variables and the addition to the longer run model of a dummy variable for the entrant failing to remain on the route.

Table 2 presents descriptive statistics on the variables in the model. Some of the more interesting observations from Table 2 are as follows:

- The incumbent's average short run price cut of $12.93 following entry was only 28 percent of the size of the entrant's average price cut of $46.12.

[13] The metropolitan areas coded with more than one competing airport were the following: New York (La Guardia, JFK, and Newark), Washington (BWI, Dulles, and Reagan National), Chicago (O'Hare and Midway), Dallas (DFW and Love Field), Houston (George Bush International and Hobby), Miami (Miami, Fort Lauderdale and West Palm Beach), San Francisco (San Francisco, Oakland and San Jose), and Los Angeles (Los Angeles, Burbank, Orange County/Santa Ana, Long Beach, and Ontario).

- The incumbent's average longer run price cut of $14.06 was higher than the incumbent's average short run price cut, indicating that incumbents were not able to raise their prices back to pre-entry levels in the four quarters following entry.
- On average, the incumbent's operating cost at $.093 per passenger-mile was slightly lower than the entrant's average operating cost of $.106 per passenger-mile.
- In terms of revenues, the incumbents were, on average, almost 3 times as large as the new entrants.
- Entrants had a passenger complaint rate more than four times the complaint rate of the incumbents.
- On average, incumbents had 43.2 percent of route market share prior to service by the new entrant.
- An entrant failed to remain on its new route for four quarters in 24 percent of our observations.

In the next section, we present the results from our two models.

4. Results

The two models were estimated both in linear and log-linear forms. As the results from the linear and log-linear models were similar, only the logged results are presented in Table 3.[14] The coefficient estimates can be interpreted as elasticities. The results

[14] Note that there were fewer observations (867 compared to 971) in the longer run model. The longer run model required the measurement of incumbent reactions four quarters after entry (compared to one quarter for the short run model). Since our last panel of data was the second quarter of 1997, the last entry events for the longer run estimation could be no later than the second quarter of 1996.

show that a number of the variables in the regression were significant determinants of the incumbent's price cut following entry.

The coefficient for Entrant's Price Cut was positive and significant in both the short run and long run estimations, indicating that the larger the entrant's price cut, the larger the short and longer run price cut of the incumbent. The short run result is in conformance with Dresner and Windle's (1999) conclusion that a major determinant of incumbent reaction to entry is the price charged by the new entrant. The short run coefficient estimate of 0.415 and the longer run estimate of 0.379 imply that a 1 percent price cut by a new entrant will trigger the incumbent to respond with a 0.4 percent (approximate) short and long run price cut, all other factors held constant. As an example, if the average incumbent price prior to entry is $100, and the entrant cuts prices by $13 (the average for our sample), one could expect the incumbent to cut prices by about $5.20 (i.e., 40 percent of $13).

The coefficient for Entrant's Passengers was positive and significant only in the longer run regression. The positive coefficient of .031 implies that in the longer run, the incumbent cuts prices by about .03 percent for every 1 percent increase in market share gained by the new entrant. In the short run, the entrant's market share (i.e., a measure of scale of entry) has no significant impact on the price cut of the incumbent.

The coefficient for Entrant's Flight Segments was negative and significant in the short run estimation and insignificant in the longer run estimation. The negative and significant short run result implies that in the time period immediately following entry, an incumbent will cut prices to a greater degree if the entrant is offering service with fewer stops (i.e., better service).

The coefficient for Entrant's Cost was negative and significant in both the short run and longer run estimations. These results imply that incumbent price cuts in response to entry are lower if entrants have higher costs, even after controlling for all of the other variables in the model. As a practical example, when a low cost carrier such as Southwest Airlines enters a route, incumbents will cut prices more aggressively than when higher cost carriers enter the market, even after controlling for the entrant's initial price cut.

The coefficient for Entrant's Revenues was positive and significant in the short run regression and negative and significant in the longer run regression. Entrant's Revenues is a proxy for the size of the new entrant. This interesting result implies that when larger carriers enter a market, incumbents will respond with larger price cuts (as compared to when smaller carriers enter a market) indicating an aggressive response. This result (i.e., aggressive price response to large new entrants) was contrary to our a priori expectations. However, in the longer run, incumbents do price less aggressively, as expected, in response to entry by larger carriers.

The coefficient for Entrant's Complaints was insignificant in the short run regression and negative and significant in the longer run regression. Entrant's Complaints was used as a proxy for the reputation of the entrant. The negative and significant coefficient implies, as expected, that entrants with poorer reputations (i.e., greater numbers of complaints) will cause smaller or less aggressive price cuts by the incumbent in response to entry.

The coefficient for Incumbent's Cost was not significant in either estimation, while the coefficient for Incumbent's Revenues was negative and significant in the short

run and insignificant in the longer run estimation. The negative coefficient for Incumbent's Revenues implies that larger incumbents will react less aggressively (in terms of smaller price cuts) following entry, at least in the short run.

The coefficient for Incumbent's Market Share was negative and weakly significant in both the short and long run estimations. This somewhat surprising result implies that incumbent price cuts will be smaller if they have a higher market share prior to entry. It was thought that the opposite case might be true; that is that incumbents with high market shares on a route would compete more aggressively with new entrants in order to defend their market share. However, it may be that carriers with high market shares have the ability to respond more selectively to price cuts than do low market share incumbents, cuting prices on only a limited number of seats.

The coefficient for slot controlled airports was negative and significant for both of the estimations. This result implies, as expected, that incumbents cut prices to a lesser extent when there are barriers to entry (i.e., slot controls) at one or both route endpoints.

Finally, an interesting result was that the coefficient for Entrant Failed on Route was insignificant in the longer run estimation. It was thought if a new entrant failed to remain on a route that an incumbent would have room to raise its price back to or close to previous levels (implying a negative and significant coefficient). However, the results show that the failure of a new entrant on a route had no significant effect on the longer run price cut of the incumbent.

Table 4 provides a summary of the results. As indicated in the table, in the short run, incumbents tend to price cut more aggressively when the entrant's price cut is large, the entrant is offering more direct service on the route, the entrant's cost structure is low,

the entrant is large, the incumbent is small, the incumbent's market share is small, and the airports at both route endpoints are not slot controlled. In the longer run, the incumbents price cut more aggressively when the entrant's initial price cut is large, the entrant carries more passengers on the route, the entrant's cost structure is low, the entrant is small, the entrant has a poor reputation in terms of number of complaints, the incumbent's market share prior to entry was low, and both route endpoints are not at slot controlled airports. Surprisingly, the failure of the new entrant to remain on the route had no effect on the incumbent's long run price cut.

5. Conclusions

The purpose of this paper was to investigate the factors contributing to competitive reactions by incumbent airlines both in the short run and the longer run. Using data on 981 incumbent reactions to entry in the U.S. airline industry between 1991 and 1997, we found several factors that have a significant impact on the level of incumbent price cut in response to entry.

Both in the short and longer run, the size of the entrant's price cut was found to be the most significant determinant of the size of the incumbent's price cut. Although this result may indicate that the major determinant of an incumbent's price reaction is "to be competitive", other results suggest that larger, more aggressive, price cuts may by used by incumbents against smaller, low cost carrier, especially in the longer run. Our longer run results indicate that incumbents cut price more aggressively when the entrant's cost structure is low and the entrant is small; i.e., the characteristics of smaller, low cost carriers. Since policymakers generally wish to promote entry by small, low cost carriers, this result in discouraging. On the other hand, our longer run results indicate that even if

the entrant is forced to withdraw from a route, prices do not rise back up to pre-entry levels. In fact, the failure of an entrant to remain on a route had no significant effect on long term prices.

From an airline management viewpoint, our results point to characteristics of potential entry routes that may trigger either an aggressive or passive response by incumbents. Managers of airlines considering new entry may want to choose routes where there are barriers to entry, for example, in the form of slot controlled airports, at one or both endpoints. We found that when carriers entered these type of routes, that the incumbent responses were less severe than would otherwise be expected. On the other hand, new entrants may want to avoid routes where there are no dominant incumbents (i.e., incumbents all have low market shares) since incumbents with low market shares tend to price cut more aggressively in response to entry.

Table 1: Variables Used in Econometric Model

Construct	Variable	Operational Variable
1. Response to Entry	Short and Longer Term Price Cut of Incumbent	Avg. Incumbent's Price Q-1 - Avg. Incumbent's Price Q+1 (Short Term) or Q+4 (Longer Term)
2. Entry Strategy	Price Cut of Entrant	Avg. Incumbent's Price Q-1 – Avg. Entrant's Price Q+1
	Scale of Entry	No. of Passengers Carried by Entrant in Q+1
	Routing	No. of Flight Segments on Route
3. Entrant Factors	Operating Cost Structure of Entrant	Entrant's Operating Cost Per Seat-Mile in the Calendar Year Before Entry
	Size of Entrant	Total Revenues of Entrant in the Calendar Year Before Entry
	Reputation of Entrant	No. of Customer Complaints per 100,000 Passengers Registered by the Dept. of Transportation in the Calendar Year Before Entry
	Ability to Remain on Route (for long run response only)	Dummy Variable Coded 1 if Entrant Failed to Remain on Route for 1 Year and 0 Otherwise
4. Incumbent Factors	Operating Cost Structure of Incumbent	Incumbent's Operating Cost Per Seat-Mile in the Calendar Year Before Entry
	Size of Incumbent	Total Revenues of Incumbent in the Calendar Year Before Entry
	Reputation of Incumbent	No. of Customer Complaints per 100,000 Passengers Registered by the Dept. of Transportation in the Calendar Year Before Entry
	Importance of Route to Incumbent	Route Market Share of the Incumbent Q-1
5. Market Factors	Barriers to Entry	Dummy Variable Equal to 1 if there is a Slot-Controlled Airport at Either Route Endpoint
	Competitive Routings Available	Dummy Variable Equal to 1 if there is a Multiple Airport City at Either End of the Route.

Table 2: Descriptive Statistics

Variable	Mean	Standard Deviation
Short Run Incumbent's Price Cut (Dollars)	12.93	37.42
Longer Run Incumbent's Price Cut (Dollars)	14.06	42.25
Entrant's Price Cut (Dollars)	46.12	49.15
Entrant's Passengers	17,630	16,810
Entrant's Flight Segments	1.25	0.39
Entrant's Cost ($/Pass-Mile)	0.106	0.084
Entrant's Revenues (Thousands of Dollars)	2,036,329	2,912,957
Entrant's Complaints (per 100,000 Passengers)	4.38	14.33
Incumbent's Cost ($/Pass-Mile)	0.093	0.017
Incumbent's Revenues (Thousands of Dollars)	5,954,517	3,573,456
Incumbent's Complaints (per 100,000 Passengers)	1.04	1.36
Incumbent's Market Share (%)	43.2	24.5
Slot-Controlled Airport (% of Observations)	17.0	37.6
Multiple Airport City (% of Observations)	54.4	49.8
Entrant Failed on Route (% of Observations)	24.0	42.7

Table 3: Estimation Results – Dependent Variable is Incumbent's Price Cut

Variable	Short Run		Longer Run	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-0.370$^{\wedge}$	0.161	-0.087	0.219
Entrant's Price Cut	0.415*	0.019	0.379*	0.026
Entrant's Passengers	0.008	0.010	0.031$^{\wedge}$	0.013
Entrant's Flight Segments	-0.160*	0.034	-0.027	0.044
Entrant's Cost	-0.079*	0.015	-0.038$^{\wedge}$	0.019
Entrant's Revenues	0.019*	0.004	-0.010$^{\wedge}$	0.005
Entrant's Complaints	-0.005	-0.008	-0.046*	0.010
Incumbent's Cost	-0.029	0.041	-0.023	0.054
Incumbent's Revenues	-0.014$^{\wedge}$	0.006	-0.010	0.008
Incumbent's Complaints	0.011	0.012	0.004	0.016
Incumbent's Market Share	-0.020$^{\#}$	0.012	-0.025$^{\#}$	0.015
Slot-Controlled Airport	-0.076*	0.021	-0.090*	0.028
Multiple Airport City	0.008	0.015	-0.006	0.020
Entrant Failed on Route	N/A	N/A	-0.019	0.023
R^2	0.395		0.296	
No. of Observations	971		867	

* Significant at the .01 level. $^{\wedge}$ Significant at the .05 level. $^{\#}$ Significant at the .10 level.

Table 4: Summary of Results

Factor	Short Run Effect	Longer Run Effect
Larger entrant price cut	Larger incumbent price cut	Larger incumbent price cut
Entrant gains more passengers on route	No significant effect	Larger incumbent price cut
Entrant's routing has more flight segments	Smaller incumbent price cut	No significant effect
Entrant has higher operating costs	Smaller incumbent price cut	Smaller incumbent price cut
Entrant's revenues are higher	Larger incumbent price cut	Smaller incumbent price cut
More complaints against entrant	No significant effect	Smaller incumbent price cut
Incumbent has higher operating costs	No significant effect	No significant effect
Incumbent's revenues are higher	Smaller incumbent price cut	No significant effect
More complaints against incumbent	No significant effect	No significant effect
Incumbent's pre-entry market share is higher	Smaller incumbent price cut	Smaller incumbent price cut
Either/both route endpoints are slot-controlled	Smaller incumbent price cut	Smaller incumbent price cut
Either/both route endpoints are in cities with multiple airports	No significant effect	No significant effect
Entrant failed to remain on route	Not applicable	No significant effect

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Yield Management Simulation

Appraisal of airline revenue in different cases

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ABSTRACT

The purpose of this paper is to estimate the real number of passengers carried in each fare class (and thus the total revenue) by two airlines operating the same route but having some differences (natural market share, knowledge of the market, prices, connecting passengers...) and using different systems to manage their aircraft loading.
To do that, a has been achieved in ENAC. Its first version (monopoly route) has been built in the framework of the PHARE European project (training for Eastern and Central Europe countries), improved in a second version and now a third one[1]. In all cases, the simulator consist of three main units:

- ***the demand forecast unit.*** *According to a number of parameters which can be chosen by the simulator user, this unit can generate a large variety of curves "number of passengers versus time of booking". With reference to this curve and to each airlines market knowledge, this unit also performs an appraisal of each airlines forecasted curves.*
- ***the real demand generator.*** *The real demand (for each class) is generated randomly in relation to the parameters chosen in the former unit and their standard error.*
- ***the inventory management unit.*** *Different systems can be used to manage the booking process : static (fixed capacity for each class), Automatic dynamic (nesting) or Yield management. This unit simulates the answer of each system to a real and a forecasted demand combination, to determine the number of passengers per fare class.*

[1] Actually a 4th version is studied in cooperation with Airbus Industry.

June 1999

ENAC

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- ***Revenue gaps*** *obtained on a same market fluctuate in a large range:* ***1 versus 3*** *level so, largely more than the cost gaps, especially if we take into account only controllable costs.*

- *More the technique used, the* ***statistic knowledge*** *of the demand seems the main issue in this field.*

- *Improving its revenue needs two conditions : having a* ***perfect knowledge*** *of the market and operate a sophisticate* ***yield management system****. Then, the airline has to increase the number of both connecting passengers (hub and spoke network) and high contribution passengers (marketing tools).*

- ***Fare war*** *has always negative impacts on revenues. Meanwhile, the dominant airline is less affected by this war than its challenger.*

- *In fact, it seems that entering or staying in a market dominating by a major airline (hub, good knowledge, loyal passengers) is quite impossible without drastic losses. The only way to do that and reduce the gap revenue is... to do the same thanks to another major airline.*

Résumé

L'objectif de ce papier est d'estimer le trafic (classe par classe) et donc les recettes de 2 compagnies aériennes exploitant la même route mais avec des éventuelles différences de demande ou d'offre (part de marché naturelle, connaissance du marché, tarifs, passagers en correspondance, part de trafic affaires....) ou/et de système de gestion de capacité.
Pour cela, un simulateur de yield management a été construit à l'ENAC. Sa première version (route desservie par une seule compagnie) développée dans le cadre du programme PHARE (formation des compagnies aériennes des PECO) a été améliorée par une deuxième et maintenant une troisième version[2]. Dans chaque version, ce simulateur comprend 3 parties :

- ***un module " prévision de la demande ".*** *En fonction de nombreux paramètres, tous pouvant être fixés par l'utilisateur du simulateur, ce module génère une grande variété de courbes "nombre de demande de réservation en fonction du temps". En référence à cette courbe, et de la connaissance du marché de chaque compagnie, ce module simule aussi la prévision pouvant être faite par chaque opérateur.*

- ***un générateur de la demande réelle.*** *La demande (pour chaque classe) est générée aléatoirement en fonction des paramètres choisis précédemment et de leurs écarts type.*

- *le module **"gestion de capacité".** Différents systèmes peuvent être utilisés dans cette démarche: statique (la capacité de chaque classe est fixe), dynamique et automatique (nesting) ou Yield management. Ce module simule les résultantes (trafic et recettes) de chaque système à un grand nombre de simulations (demande réelle et prévisions de chaque compagnie).*

Les résultats trouvés sont particulièrement intéressants :

- ***les écarts de recette** sur un même marché peuvent varier dans de larges proportions, de **1 à 3,** soit beaucoup plus que les écarts de coût surtout si l'on se limite à la partie "contrôlable" des coûts.*

- *Plus que la technique utilisée la **connaissance statistique** de la demande paraît l'élément essentiel.*

- *Améliorer sa recette nécessite néanmoins de réunir deux conditions : **connaître le parfaitement** le marché et disposer d'un outil de type **yield management**. Les 2 voies à suivre sont alors, l'accroissement du nombre de passager en correspondance (réseau hub & spoke) et de la part de passagers haute contribution (marketing).*

- *La **guerre tarifaire** a toujours des résultats négatifs cependant, la compagnie leader (plus de passagers affaires et/ou de correspondances, meilleur connaissance...) souffre nettement moins que son challenger.*

- *En fait, il semble que l'entrée ou le maintien sur un marché desservi par une compagnie historiquement bien implantée et possédant donc une bonne connaissance de celui-ci, des passagers fidélisés et des correspondances est pratiquement impossible sans pertes colossales. Le seul moyen de limiter l'écart de revenu est... de faire pareil avec l'aide d'un partenaire lui même compagnie major.*

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[2] Une 4ème version est étudiée en collaboration avec Airbus Industrie.

95...) with an economic stake less important than its indirect impacts. This situation and the requirement to protect a new-born activity has given it an unique regulatory framework (ICAO 96, OCDE 89, Bresson 93 et 95) creating co-operation between airlines.
The numerous modifications of the activity, either quantitative (maturation, infrastructures modification of the activity saturation...) or qualitative (users and product segmentation), and the technological improvements (production but also distribution) have transformed this state controlled co-operation in tooth and nail fighting.

With this background, each airline has to use comparative advantages to stay in the field. Three of them (Bresson 98) can be enumerated:

- Historical advantages which are linked to traffic rights (due to bilateral agreements), airport rights (mainly but not only slots), and marketing rights thanks to Frequent Flyer Program or special agreements with travel agencies.
- Lower production costs often for external reasons. For example, the level of personnel cost depends on the airline headquarters location.
- Finally, higher revenues which seem the most controllable way to improve the result of an airline.

According to this short analysis, handling and optimizing their revenues becomes one of the main objectives of an airline. To do this, number of capacity management systems can be used and yield management is the most sophisticated one. In the literature, we found some interesting papers on this subject but these mainly relate to yield management theory (for example Daudel and al 94, Wei 97 or Sinsou 99). In fact, it's very difficult to evaluate the yield management benefit in this way since too many parameters must be taken into account. Only simulation can be used to obtain this appraisal. MIT team of Professor Belobaba (i.e. Belobaba and al 97, Belobaba 96...) have worked on this subject and set out (i.e. Belobaba and al 97, Belobaba 96...) interesting works.
We have tried to do so in ENAC first as a pedagogical objective: simulating different scenarios to give for example a measure of revenue management involvement. A first simulator has been obtained in the framework of the PHARE European project and used to train the personnel of some Eastern European Airlines. This first version was limited to the simulation of the impact of the technique used to book the aircraft (*Yield management, other inventory management system or, no system...*) on a monopoly market. In this case, all our simulations allow us to say that, the yield management system is a very efficient revenue booster tool, but its performances are so much more important when:

- The demand is higher in regard to the supply. A condition all the easier to fulfil since the airline can complete its flights with many connecting passengers.
- The airline has a leadership on one or several domestic markets, giving it a large "high contribution traffic".
- The airline has a very complete knowledge of the market.

Soon, it seems that this representation is too simple because, in fact, there are often two, or more airlines in the market, each of them characterized by its size (and so its past market share), its supply, its range of fare and, its typical demand (i.e. connecting passengers).
For this reason, we have produced, with a group of students, a second simulator. Then, to take into account all interactions between parameters and results, a third version (this one is used here) has been built this spring. A fourth one is actually in development in cooperation with Airbus Industry.

A yield management simulator has to include three different units.

1.1. The forecasted demand unit

At the beginning of the booking process of a flight (we assume 3 months before departure), all airlines have to forecast the number of passengers at take off for each fare class or (better but more difficult), the associated curves "number of passengers versus time". The main problem in this appraisal is, of course, the accuracy of the forecast. In fact, this accuracy depends on two parameters.

- the market fluctuation which is common to all airlines.
- the knowledge of the market possessed by the forecaster. Contrary to the first parameter, this one is quite different from one airline to the others.

In respect to the diversity of these two factors, we have decided, for each class, to perform the valuation of the forecast demand in two steps.

1.1.1 the "ideal curve".

We suppose, in this step, that the forecaster has a perfect knowledge of the market. Then, each curve can be described by a number of parameters:

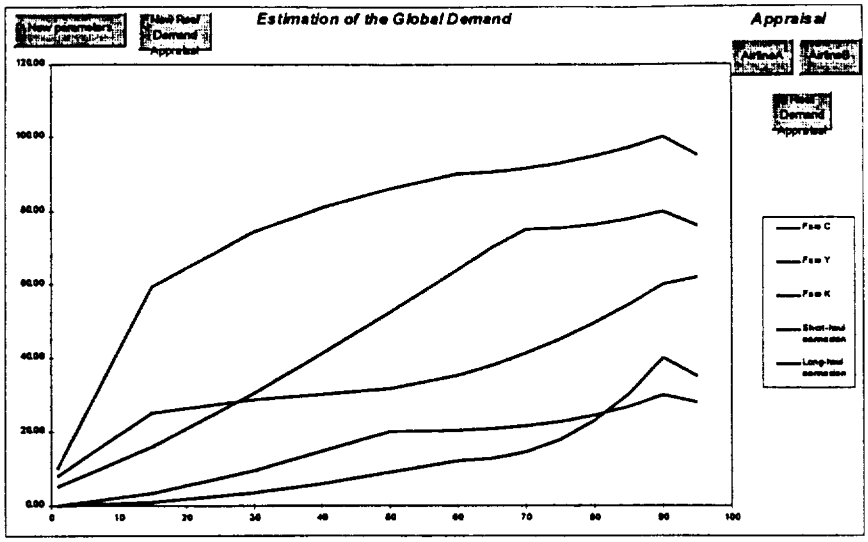
- Three specific points. Each of them is characterized by its axis X value (time before take off) and its Y-axis value (number of passengers who has already booked a seat or try to do so). Two of these three points are fixed on X-axis: beginning of the booking process (point 1) and beginning of the registration process (point 3). The third one (point 2) can be chosen between the two other points. It's supposed to be an inflexion point (change in the curve concavity).
- The curve concavity between each couple of consecutive points (1-2 and 2-3).
- Finally, the so-called go-show and no-show passengers who must be, respectively, add and subtract to the "beginning registration process" traffic to get the traffic at take off.

The user of the simulator can easily choose any value for each parameter. He can also fix all the associated standard errors reflecting market fluctuations.
Finally, according to these numerous assumptions, he can choose, for each fare class, any possible booking process curve.
In the version of the simulator used here, 5 fare classes are available.

- **C fare class.** The highest contribution local passengers (point to point) use this class. We generally suppose that the demand is flat at the beginning of the booking process but, some days before departure (inflexion point), its growth rate becomes high.
- **K fare class.** This one is the lowest contribution local passengers one. At the opposite of C class, the demand (simulated by fare restrictions) is strong a long time before departure but very flat after the inflexion point.
- **Y fare class.** "Average contribution" local passengers use it. So its curve is supposed to have a quite steady growth rate.
- **Short haul connecting passengers class.** It's a combination of the 3 former classes but its curve is close to C class one.
- **Long haul connecting passengers class.** It's also a mixture of the 3 local passenger classes but its curve seems close to Y or K class ones.

Graph 1 next page is an example of curves linked to a complete choose of assumptions.

Graph 1: Demand per class



1.1.2 Each airline forecasted curve.

The gap between the ideal curve and each airlines real curve depends on the level of knowledge the airline has acquired. The level which is the synthesis of a number of items as its experience (or its partners one) of the market, its investments in obtaining data (MIDT). We can characterize this knowledge by a figure, which is, the standard error of its forecast.
Then, we can proceed to a random pull each "airline forecasted curve" parameters in relation to the "ideal curve" value (assumptions performed before) and this new factor. These new curves (one per fare class) could be quite different to the former ones.

1.2. The real demand generator

1.2.1 The global demand.

To perform a simulation, we must know the real curve, which can be quite different to the former ones (including the ideal curves since the market is fluctuated). In fact, to reduce the computer time, we have summed up each curve to 15 points steadily spread over the X-axis. For each class and each of the 15 points, the real value is the result of a random pull taking into account the "ideal curve" value and the standard error of the demand for this fare class.
To have a significant leaning, it's necessary to proceed to a large number of simulations with the same parameters (random pull of the real demand). Moreover, to compare the result of each group of simulations, it's necessary to have not only the same real demand but, the same airlines forecasted curves. To do that, we have created and stored one hundred of each set of data. Each set includes, for each class all values associated to the real demand and each airlines forecasted curves.

1.2.2 Each airlines demand.

Until now, we have not spoken of market share, as in each case, our reference has been the whole demand. In the inventory process (1.3), each airline has to handle its own demand and, in addition, a part of the demand that the other airlines cannot satisfy.
Each airlines market share is supposed to be linked to two elements the simulator user can change.

- Its natural market share. This figure is the synthesis of a lot of issues: history of the market, airline brand, frequency, aircraft used, network... Since all market segments (i.e. connection) are not always operated, the sum of each airlines natural market share can be lower (or higher) than 1.

and over-booking costs. Yet each airline can choose different prices. In this cases, three effects must be simulated.

- Variation of its natural traffic (Total traffic x Natural market share)
- Variation of other airlines natural traffic.
- Transfer of traffic between airlines.

We have simulated this price effect by two new assumptions for each class: direct elasticity to price and transfer elasticity. The result is the real market share for each airline. Of course, as for natural market shares, the sum of real market shares can be different (lower but also, fare war, higher) than 1.

With these new elements, we can know, for each simulation, each airline and each fare class:

- the demand (total demand x real market share)
- the forecast performed at the beginning of the booking process (total forecast x appraisal of its real market share).

An important issue is the way each airline forecasts its real market share and then, it's demand curve. Since this demand is not only its own one but also a part of its competitors ones, the airline has to modulate its initial forecast by a ratio. We have simulated this ratio by an "aggressivity level" the value of which can be chosen between 0 (only own demand is considered) and 1 (the whole demand is taken into account).

1.3. Inventory management unit

This is the heart of our simulator. Each airline is now facing a demand and it has to define the booking limits for each fare class. Each reservation recorded alters this initial inventory. In this process, called inventory control, different methodologies can be used. We have simulated 6 of them and in each couple of simulations, the user can choose, for each airline, one or another of those methods. But, before describing those methods, let us explain the general issue of this process.

1.3.1 Generalities and common assumptions.

1.3.1.1 Capacity allocation.

In each method (except one), it's necessary to make a first allocation of capacity. This first allocation, based on forecasted demand, can stay steady (static methodology) or can be changed according to the real level of the demand (dynamic methodology).
Two methods can be used to determine this first allocation.

- **Standard**. The capacity is allocated, from the highest to the lowest contribution fare class, in regard to the forecasted demand, the standard error of its valuation and a confident rate. The same way is used to determine overbooking rate.
- **Yield Management**. In this case, the optimal number of units to protect for each class is obtained by a comparison of each class of incremental passenger revenue expectation. This one, for an additional seat, is equal to the product of the fare associated (R_i) by the probability (P_i) that such an additional unit will be sold in this category. So the balance between passenger class A and passenger class B can be write: $R_b * P_b > R_a * P_a$

  To determine the overbooking rate, the same methodology is used. For allocating an additive over-capacity seat, the comparison is made between the revenue of this additive seat (the best $R_i * P_i$) and the cost link to a probability of overbooking ($C_{overbooking} * P_{overbooking}$)

When all the capacity allocated to a specific class is sold, it's not possible to book any another seat. We have supposed that, in this case, the denied passengers try to find a seat in another airline in the same fare class.
Then, the real demand of each airline is in fact the addition of its real demand (improperly predicted) and, the denied passengers of other airlines (unpredicted).

1.3.2 Different inventory control methods.

For each airline, the user can choose among 6 inventory control methods:

- **FCFS** (First come, first served) passengers acceptance rule. In this case, all demand of booking is agreed until the aircraft is full.
- **Standard static**. The first allocation is made by standard method (1.3.1.1), and this initial allocation is never changed during the booking process.
- **Yield Management Static**. Like standard static, the first allocation, computerized this time with yield management concept, is never changed during the booking process.
- **Standard nesting**. This is the simplest dynamic method, capacities are nested. It means that the real total capacity allocated to a class j is equal to $C_j + \Sigma C_i \; p_i < p_j$ (with C_i first allocation of Class i computerized by yield management concept). After a booking in class j, the number of seats allocated to class j and all classes with a higher contribution is reduced by one unit.

  $$C_i \rightarrow C_i - 1 \; \forall \text{Classes with } P_i >= P_j$$

- **Protective nesting**. Capacities are nested as before, but this time, after a booking in any class, the number of seats allocated to all classes is reduced by one unit.

  $$C_i \rightarrow C_i - 1 \; \forall \text{Classes}$$

- **Yield Management**. This time, using the yield management concept, the allocation is computerized after each booking (more exactly, at the end of each period).

2. First results – Basic case and variation

Since a lot of parameters can be chosen, it's not easy to fix a basic case. We do that with some assumptions:

- Two similar airlines operate the route. Their traffic is mainly local since any airport linked is not a hub. Their fares are equal, as the capacity of their aircraft (120 seats) and their market shares. In fact only their knowledge of the market is different, airline A is supposed to have a better experience.
- The cumulative demand (for 100 simulations) is close to the total capacity. Respectively: 22 595 passengers and 24 000 seats, so the maximum load factor is 94%. This total demand can be pigeonholed as follows:

	Y	K	Short Connect	C
14.3%	33.6%	42.2%	2.7%	7.3%

- Since, each airline has an imperfect knowledge of the market, each forecast (by random pull) is quite different. The two valuations are respectively 23 608 (A) and 33 145 (B).

- each combination of inventory management systems
- a lot of simulations with a higher traffic (all segments or a part of it)
- a lot of simulations with a fare variation (airline A, B or both airlines)...

Each time, the result includes a lot of figures: for each airline, traffic and revenue generated for each fare class and overbooking passengers for 100 flights. A sum up of these main results and the associated comments are reported in the following paragraphs.

2.1. The two airlines use the same inventory management system.

	Trafic			Revenue (10^3)		
	Airline A	Airline B	Total	Airline A	Airline B	Total
FCFS	10 959	11 121	22 080	8 942	9 132	18 074
Standard Static	8 280	6 151	14 431	7 882	6 607	14 489
Y.M Static	10 597	9 395	19 992	8 801	8 230	17 031
Standard Nesting	10 637	9 488	20 125	8 862	8 333	17 195
Protective Nesting	9 098	8 052	17 150	8 036	7 497	15 533
Yield Management	11 237	8 995	20 232	9 311	7 992	17 303

At first sight, these results are quite surprising: if the two airlines use the same system, the best global revenue is obtained when this system is FCFS... In fact, this result is due to a level of the demand very close to the supply, so there are not many denied passengers. If we performed the same simulation with respectively, 20% and 40% more traffic (see below), the result of the yield management system is better while FCFS is worse.

	ΔTraffic 20%		ΔTraffic 40%	
	ΔRevenue	Revenue	ΔRevenue	Revenue
FCFS	-2%	18.2	-7%	16.8
Yield Management	+5%	17.7	+11%	19.2

This is in fact a confirmation of the first former important result (Yield Management simulator 1.0): ***Higher is the demand in regard to the supply, better is the yield management.***

If the two airlines have very close revenue when they both use FCFS, airline A earns more (between 4 and 8%) than airline B when they both use a real inventory control system. The highest gap is obtained when they have both implemented a yield management system. In this case, A revenue is higher than its FCFS one (4.1% more) while B revenue is lower (3,6% less). This is also the confirmation of a former result (Yield Management version 1): ***Better is the market knowledge, better is the yield management system.***

We have obtained all those results with both airlines "aggressivity ratio" equal to 0. How do they do this if ratios have a different value?

In this case, even if only one ratio is different from 0 and whatever inventory management system used (except FCFS), the two revenues decrease and, this decrease is

- much more important when the ratio value is higher.
- more important for the most aggressive airline.
- not symmetrical: for two symmetric couple of values; airline B decrease is greater than that of airline A.

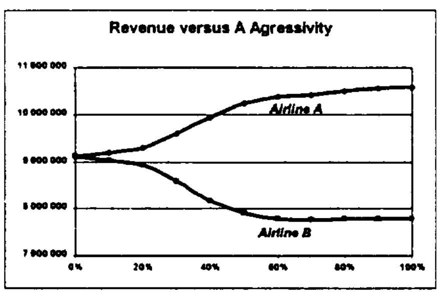
2.1 One airline uses yield management system while the other uses FCFS.

	Traffic			Revenue (10^3)		
	Airline A	Airline B	Total	Airline A	Airline B	Total
Airline A	10 782	11 343	22 125	9 114	9 118	18 232
Airline B	11 499	9 721	21 220	8 509	9 043	17 552

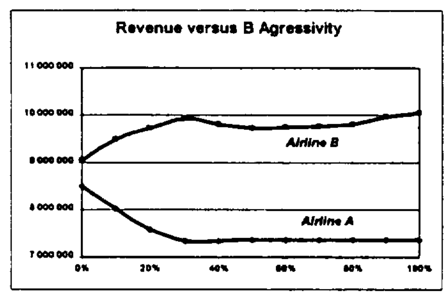
The best total revenue has been obtained when airline A uses yield management but, in this case, both revenues (A and B) are equal. On the contrary, if airline B uses yield management, the total revenue is lower but there is a gap between the two airlines. This quite surprising result can be explained by the problem of the market knowledge. In fact, yield management analysis is disturbed by the gap between the real demand and the forecasted one. But since each airlines real demand is the total of its own and the denied passengers of the other airlines, this disruption is all the higher because other airlines filter their passengers.
Two variations can be made:

- With a non-zero aggressivity ratio. The two graphs below (two cases) show each airline revenue versus the agressivity ratio of the airline using yield management. The gap between the two airlines grows like this ratio, but, this improvement can be higher for airline A (a revenue level not far from 11 millions of FF) than for airline B (the revenue stays around 10 millions FF).

A Y.M – B FCFS



A FCFS – B Y.M



- With different traffic levels (see below). If traffic grows, total revenue (in both cases) stays steady but, while the revenue of the airline using yield management increases, revenue for the other airline decreases and the gap grows.

	ΔTraffic 20%		ΔTraffic 40%	
	ΔRevenue	Revenue	ΔRevenue	Revenue
A Uses YM		***19,0***		***18,9***
Airline A	+14%	10,5	+24%	11,3
Airline B	-6%	8,5	-17%	7,6
B Uses YM		***18,1***		***18,6***
Airline A	-13,0%	7,5	-20%	6,8
Airline B	+18,0%	10,6	+30%	11,8

2.2 A uses yield management system while B uses another inventory system

	Traffic			Revenue (10^3)		
	Airline A	Airline B	Total	Airline A	Airline B	Total
B: Y.M Static	11 123	9 436	20 559	9 221	8 263	17 484
Standard Nesting	11 111	9 550	20 661	9 195	8 391	17 586
Protective Nesting	11 316	8 185	19 501	9 276	7 656	16 932

With the two former variations (agressivity and traffic), results are quite different:

- If airline A is more aggressive, like in 1.1.1, the two revenues stay steady then decrease.
- If traffic grows, each airline improves its revenue. The best improvement is for A and then, the gap A-B increases.

2.3 B uses yield management system while A uses another inventory system

	Traffic			Revenue (10^3)		
	Airline A	Airline B	Total	Airline A	Airline B	Total
A: Y.M Static	10 652	9 046	19 698	8 843	8 013	16 856
Standard Nesting	10 730	9 038	19 768	8 939	7 999	16 938
Protective Nesting	9 090	8 987	18 077	8 156	7 948	16 104

These results really show the knowledge advantage. Contrary to the former simulations, it's not the yield management user who has the best result, but always airline A whatever system (except FCFS). The gap is between 2 and 10%!

As a conclusion, yield management is a very competitive system which can give a wider benefit especially if:

- The potential traffic (demand) is high in regard to the supply.
- The knowledge of this demand is accurate. For that reason, it's interesting to take into account the opponents inventory systems to choose a level of aggressivity.

It's now interesting to study different ways to improve the potential traffic and then the yield management benefit. In fact there are three ways:

- Decrease fare and then increase low-contribution traffic.
- Create a hub and spoke network (alone or with partner) to improve connecting traffic.
- Simulate high contribution traffic with FFP or other marketing tools. Contrary to the other ways, in this case, the total high-contribution traffic stays steady but, each airline market share moves.

These three ways have been simulated and the results are described in next chapters.

3. Fare leverage.

In this chapter, we have studied the impact of a fare cutting. Since the elasticity of the high contribution class is very small, this reduction has been done for only two fares: K (from 500FF base case to 300FF) and Y (from 900FF base case to 800FF). Two cases of simulation have been performed: one airline decreases its fares, both airlines do this.

3.1. Only one airline decreases its fare.

If only airline B decreases its fares and both airlines use an inventory management system, the results for almost all simulation (whatever couple of yield management systems) are close. Each airline has a worse result: around –20% for airline B and –5% for airline A. The best result has been observed when the two airlines used yield management, in this case, the figures are respectively –18% & -1%.

The results are very similar if only airline A decreases its fares. Nevertheless, the losses of airline A are lower than the former case airline B ones (between 3 and 4%).

very different: 3 cases

- None of the two airlines uses an inventory management system. In this case, losses of the airline decreasing its fare are very wide (around –40%) while its opponent improves its revenue (around +10%).
- Only one airline uses an inventory management system (supposed to be yield management) and it is this airline which decides to decrease its fares. The results of the two likely cases are quite different (see below).

	Airline A	Airline B
A YM decreases its fares	-6%	-10%
B YM decreases its fares	-17%	-1%

Like the former 2.2 result this array seems quite surprising, with a worse market knowledge, airline B stands up better to a fare war.

In fact, if we suppose now a non-zero aggressivity ratio, the results (see below) are very different. With a fare cutting and an aggressivity ratio equal to 1, airline A improves its revenue while airline B damages its one. The symmetric scenario (B decreases its fares), the implementation like the damage is smaller.

YM aggressivity	Airline A	Airline B
A YM decreases its fares	+20%	-17%
B YM decreases its fares	-6%	+4%

Reference same scenario with aggressivity 0

- Only one airline uses an inventory management system (supposed to be yield management) but it's the other airline which decides to decrease its fares. In the two cases (A or B), the results are similar, the fare cutting down airline has a drastic loss of revenue (around - 40%) while the other improves it's own (around 10%)

3.2 Both airlines decrease their fares.

If both airlines use an inventory management system, they all have around 20% revenue cuts. However in all simulations (whatever the couple of inventory management system), three remarks can be made:

- The loss is lower for airline A (between 3 and 5%).
- The best results have been obtained for airline A when it used yield management, but for airline B with protective nesting.
- The best result for airline B (a loss of 19,3%) is worse than the worst result of airline A (-17,8%).

If both airlines use FCFS, they all have a drastic 30% cutting down of their revenue.

Finally, if only one airline uses an inventory management system (Yield management) and the other FCFS, the result are unsymmetrical. While the revenue of the yield management user stays quite steady, the other one has a wide loss (around 40%). This conclusion can be made whatever casting but the gap between the two airlines is wider if A is the yield management user.

remark must be changed:

- If A is the yield management user, it has got 10,5 million FF revenue (one of the best one) and then an implementation of 15% (in regard to basic case with a 0 aggressivity ratio) while B has it's worst 4,3 million FF revenue (-60%).
- If B is the yield management user, it has got a 9,4 million FF revenue (improvement of 2% in reference to basic case) while A has a 5 million FF one (-50%).

As a conclusion to this chapter, fare war is not really a competitive way to boost revenue, especially if both airlines have an inventory management system. In this case, the better the market knowledge, the lower the damage.
Nevertheless, if only one airline uses a capacity management system, it can have a benefit by decreasing its fares especially if its knowledge of the market is better than its opponents and, its fare cutting has been made with a capacity management aggressivity. For its opponent, no change of the fare structure seems the best way to bear up against this offensive.

4. Hub & Spoke operations – Connecting passengers growth.

If at least one of the connected airports is a hub, the result can be quite different since a supplementary traffic must be taken into account: connecting passengers (long & short haul ones). In this chapter, we have simulated this situation in three cases: only one airline (A or B) operates a hub and both airlines have a hub and spoke network.

Of course, the simulator can be used with different levels of connection. Here, we have decided to choose, in each case, only one level: in regard to the basic case, about 3 times more connecting passengers. This increasing of connecting passengers gives also an improvement of the total traffic.

4.1 Airline A operates a hub airport.

If airline A uses yield management, its total revenue is always (whatever B inventory management system) better than 11,4 million of FF (level never reaches until now). The best result (11,9 million FF) has been obtained when B uses FCFS. Airline B, whatever its inventory management system, has always the same revenue (between 7,8 and 7,9 million of FF), and then has got no benefit by using costly yield management.

If now airline A chooses another inventory management, its revenue varies in a lower range: between 9,2 (protective nesting) and 10,9 (standard nesting). At the opposite, airline B revenues stay in the same former 7,8-7,9 range.

4.2 Airline B operates a hub airport.

The symmetrical former assumption (airline B uses yield management) gives a worse result. This time, B revenue stays always lower than 11millions of FF (A uses FCFS) and in fact a narrow 9,6-9,7 range, 2 million or 20% less than before! More interesting, if airline A revenue stays almost always in the former 7,8-8 range, it reaches 8,7 million FF if A is a yield management user. Contrary to the former case, yield management gives a wide benefit to A (non-hub operator). These two results show an interesting measure of the market knowledge impact.

4.3 Both airlines operate hub airports.

Three groups of simulations have been used: both airlines use the same inventory management system, only airline A (then B) uses yield management while airline B (then A) uses another system.

In the first case, the only difference between the two airlines (same demand, same price) is their market knowledge. Nevertheless, excepting FCFS simulation (each airline has got a 9,5 million FF revenue), airline A always has better results (between 7% and 18%) than B. The wider gap is obtained when both airlines are yield management users. In this simulation, airline A earn 11,7 million of FF while A has only a 10 million FF revenue.

If only A uses yield management, the gap between the two airlines grows and reaches 45% if B uses FCFS. In this last case A revenue has the top 12,2 million FF value.

If the only yield management user is now airline B, the results are very different. When A uses FCFS, B revenue reaches only 11,4 and the gap is narrower than before. In all other case, A earns more than B though the latter uses a more sophisticated system. This is a new measure of the market knowledge impact.

The conclusion of this chapter is very different to chapter 3 one. At the opposite of fare war, development of connecting traffic is a very efficient way to boost its revenue. In this case, yield management is a very interesting tool but, its output depends a lot on the airline market knowledge. In fact, it seems quite as beneficial to improve this knowledge as to improve its inventory management system.

5. Improvement of high contribution market share.

Until now, each airline has had the same "natural market share" and then, their only differences were market knowledge, or strategic decisions such as price cutting pr hub implementation. In this chapter, the two airlines are quite different. One of them has been supposed to have a wider "high contribution passengers market share" thanks to its better brand, its higher number of frequency or its passengers loyalty improved by an efficient frequent flyer program.
Two groups of simulations have been performed: the highest "high contribution passengers market share" airline is either A or B. In the two cases, the same assumption of market share has been made: 75% and 25% in spite of the former 50-50%.

5.1 Airline A has a wider "high contribution passengers market share".

Whatever the pair of inventory management systems, all simulations give the same result: in regard to basic case (see below), airline A improves its result in spite of a traffic reduction while airline B improves its traffic but damages its revenue.
For airline A, the best results are obtained with yield management. In these cases and whatever the system used by B, A earns almost 10 million FF and the gap A-B varies between 15 and 33%.
This remark is unsymmetrical, for B and whatever the system used by A, the best results are obtained with FCFS. To this way, when A operates yield management system, the narrower gap A-B (15%) is obtained with B FCFS user.
Finally, turning down the non-efficient standard static system, for both airlines, protective nesting is the worst system.

	Airline A	Airline B	Airline A	Airline B
The two airlines use the same system				
FCFS	1.4%	-1.7%	4.3%	-4.7%
Standard Static	-12.1%	10.0%	3.0%	-5.4%
Y.M Static	-2.6%	10.6%	6.3%	-3.3%
Standard Nesting	-2.7%	10.8%	6.0%	-1.9%
Protective Nesting	-2.8%	13.2%	6.8%	-0.3%
Yield Management	-3.9%	7.1%	5.0%	-4.6%
Airline A use Yield Management				
B: FCFS	-0.5%	0.0%	6.7%	-7.1%
B: Y.M Static	-2.8%	10.5%	5.8%	-3.4%
B: Standard Nesting	-2.8%	10.6%	5.8%	-2.6%
B: Protective Nesting	-3.8%	7.3%	5.5%	-3.9%

Reference basic case

5.2 Airline B has a wider "high contribution passengers market share".

Two main differences must be noticed in this unlikely scenario:

- All improvements (traffic and B revenues) are lower than before while all losses revenue and B traffic) are higher.
- The worst result is not always those of A. For example, if the two airlines use yield management, in spite of its higher high contribution passengers market share, B earns less than A. In fact, the B best result has been obtained when both airlines use FCFS.

	Revenue		ΔRevenue (1)		Symmetric ratio (2)	
	Airline A	Airline B	Airline A	Airline B	Airline 1	Airline 2
The two airlines use the same system						
FCFS	8.4	9.7	-6.6%	5.9%	3.7%	4.2%
Standard Static	8.3	4.6	5.4%	-30.5%	-43.4%	-24.7%
Y.M Static	8.1	8.4	-7.8%	2.0%	-10.2%	-1.9%
Standard Nesting	8.2	8.5	-7.5%	2.1%	-9.4%	-0.4%
Protective Nesting	7.7	7.6	-4.2%	1.1%	-11.7%	-2.9%
Yield Management	8.7	8.2	-6.4%	3.0%	-15.8%	-12.5%
Airline B use Yield Management						
A: FCFS	7.8	9.1	-14.3%	0.1%	-6.1%	8.5%
A: Y.M Static	8.2	8.2	-11.2%	-1.1%	-16.2%	-2.5%
A: Standard Nesting	8.4	8.2	-8.8%	-2.9%	-16.3%	-2.6%
A: Protective Nesting	7.7	8.2	-17.3%	6.8%	-16.5%	-4.1%

(1) Reference basic case

(2) Airline 1 has the highest C passengers market share ratio = B in regard to A results
Airline 2 " " lowest " "

Symmetric ratios (comparison 5.1 and 5.2 simulations) show clearly the market knowledge impact. Excepting when both airlines use FCFS:

- The highest market share revenue is between 10 and 17% lower when the observed airline is B.
- The lowest market share revenue is also lower when the observed airline is B, the gap reaches 12,5% when the two airlines use yield management.

This chapter confirms former ones, good market knowledge is essential since it is a necessary condition of yield management efficiency.

6. Real cases.

In a real air transport market, unlike the basic case, airlines natural market shares are often quite different. In fact, the leader airline often enjoys cumulative advantages like high contribution and connecting passengers market share, market knowledge...

For these motives, we have performed a number of simulations with new assumptions: airline A with a better market knowledge operates a hub and spoke organization (Chapter 4), has got a higher C class passengers market share (chapter 5) and has implemented a yield management system. In this situation (see below), the revenue gap is close to 1/3 whatever the inventory management B uses.

	Revenue		Gap
	Airline A	Airline B	B/A
Yield Management	12.1	7.7	-36.6%
FCFS	12.5	7.6	-39.4%
Y.M Static	12.0	7.9	-34.1%
Standard Nesting	12.0	8.0	-33.2%
Protective Nesting	12.0	7.6	-36.6%

We have asked ourselves about different B strategies to react against this important handicap. Four of them have been successively studied:

6. 1 B uses a smaller aircraft

If airline B decreases its aircraft capacity (100 in spite of 120 seats), we have obtained two type of results:

- B uses FCFS. A improves its revenue (2,8%), B damages drastically its one (21%), probably more than its costs.
- B uses an inventory management system. A improves weakly (between 0,3% and 0,5%) its revenues. B damages its one (around 10%) but, since its capacity and then its traffic decreases, this lowering comes with a yield (around 6%) improvement. The best B result has been got when it uses protective nesting.

Then, this strategy (very protective) can be used only to protect specific situation not really to enter in a new one.

6.2 B cuts down its fares

Both airlines have a revenue decreasing:

- between -0,7% and -1,3% for airline A (except a 1,6% improvement when B uses FCFS)
- but nearly -20% (even –35% with FCFS) for airline B.

A new time, this strategy seems without any interest.

6.3 B improves its connections by another airline agreement

This agreement increases the route traffic and then both airlines improve their revenues:

- between 1 and 2% for airline A.
- More than 10% (but only 3,3% with FCFS) for B. The best result (12,5% improvement) has been obtained with yield management.

This time, this strategy seems quite interesting for B. Moreover, in the long term, an improvement of both its market knowledge and its high contribution market share could be obtained and more easily thanks to its partner.

6.4 Combination of 6.3 and 6.2

Excepting when B uses FCFS (B revenue decreases drastically from 30% while A one improves weakly) both airlines keep its revenue quite steady (between –1 and +3%). Meanwhile, since B result has been got with a weaker B traffic, next improvement could be easily foreseen with a better market knowledge.

7. Conclusion – next developments.

This number of simulations confirms our model 1 (monopoly route) simulator: yield management can generate a revenue improvement but widens this improvement. Thus, with exactly the same market (same hundred demand curves), the gap between the all couple of results can reach a 1 versus 3 level! Some figures:

- The maximum revenue (12,8 million of FF) has been obtained by Airline A (real case and B using FCFS).
- The minimum one (4,7 million FF) is around three time less (real case, Airline B using YM and cutting down its fares).
- If we examine the total earning of two airlines, it fluctuates from 12,8 millions of FF (both airline cuts their fares) to 21 millions (real case, B using standard nesting and obtaining a partner agreement to code-share).

These figures are of course to a wider extent than operation costs, especially if we take into account, in these last ones only controllable items... Then, we can confirm our former assumption: optimizing revenue has to be the main airline objective.

Another interesting conclusion is linked to the market knowledge function. This one seems more important than the management inventory technique itself. Thus, in numerous cases:

- Airline B (supposed to have a quite unperfected market knowledge) has no interest to use yield management (FCFS gives it a best result).
- Airline A with less favorable conditions than B but a better market knowledge has better results.
- In all symmetrical scenario, Airline A earnings are better than B ones.

When the two main conditions (good market knowledge and implementation of a yield management system) are fulfilled, an airline (to improve its revenue) has interest in increasing its high contribution market share and the number of its connecting passengers. In this case (real case?), it can enjoy a more than one-third revenue benefit versus its opponents! For this one, there is only one way to show resistance: do the same with a partner.

On the contrary, fare wars always come with drastic revenue decreases. Each time, airline B (with the worst market knowledge) lost more than A and then, fare war seems only an interesting medium term way to keep a new airline from entering the market dominated by another airline.

Finally, if we sum up these former remarks, it seems quite impossible to enter a market linked to a major airline hub if the entrant is not associated with another major airline...

All these simulations have been performed on the same market (a typical short-medium intra-european flight) and, in almost case, with the same aircraft. Two main future developments have been planned:

- Perform the same analysis on a long-haul market
- Take into account the aircraft capacity impact.

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inventory management system. This valuation has been performed in a variety of cases: level of the demand versus the supply, fluctuation of the demand, knowledge of the market, fare level, number of connecting passengers... In each case, to have a strong evaluation a great number of simulations have been performed showing mainly the market knowledge impact.

Airline In-flight Entertainment: The Passengers' Perspective

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Abstract

Following relaxation of economic regulation in many aviation markets, the competition amongst airlines has intensified in recent years. This has resulted in improvements in airline products, especially in the in-flight services. One of the areas on which airlines have focused their attention is the provision of personal In-Flight Entertainment (IFE). In 1998, airlines spent $1.8 billion on IFE. However, the industry is faced with a number of questions in relation to such levels of investment: Are the investments justified? Does IFE influence passengers' choice of airline? Does IFE have a revenue generating potential? What does the future hold as far as the IFE services are concerned? This paper addresses these questions based on a passengers survey and literature review. The results indicate that while IFE is not amongst the primary factors affecting passengers' choice, it contributes greatly to passengers' satisfaction with airline services. While provision of IFE can currently act as a differentiating factor, in the future it will become part of passenger' expectations. It has also become apparent that, while IFE has the potential to generate some revenue, it would not be enough to cover the total costs associated with the installation and running of IFE systems. The impact of IFE would be felt, indirectly, through increase in passenger loyalty which should have a positive impact on airline revenues.

Keywords: airline passenger preferences, in-flight entertainment, product differentiation

1 Introduction

With the increase in the level of competition in most air transport markets, airlines are continuously seeking ways of differentiating their product from one another. In recent years, one of the areas for product differentiation has been the development of In-Flight Entertainment (IFE), in which airlines are investing a huge sum of money. The increase in the IFE expenditure has been due to airlines moving away from the old overhead distributed services to video and audio systems which are installed in the back or the armrest of individual seats. Table 1 shows a sharp increase in airline industry expenditure on IFE and related communications in recent years.

In early 1990, airlines were spending $1,800 per seat for their IFE systems, in 1998 $6,000. In the year 2000, the expenditure per seat on IFE is expected to reach $10,000 (Airline Business,1999). Airbus estimated that IFE accounts for 2% of overall costs of

aircraft. It must also be borne in mind that such investments are typically written off over three to five years period.

Table 1: Airline investments in IFE, 1992-1998

	(US $) billion
1992	0.40
1993	0.60
1994	0.80
1995	0.84
1996	1.20
1997	1.37
1998	1.75

Source: World Airline Entertainment Association (WAEA),1999

IFE is also a considerable weight factor, as it has been estimated that over the last 10 years 6 kilos have been added to every seat in aircraft equipped with such systems (Kelly, 1999).

Airlines generally develop product and services to achieve three goals; a) to satisfy customers needs and requirements: b) to meet the company's corporate objectives, or in other words satisfy shareholders by producing profits and c) to out-perform the competitors through product differentiation. Therefore, such a heavy investment by airlines in IFE systems raises a number of questions in relation to the role and the impact of IFE in the total airline product, which are as follows:

- How important is IFE in passengers' choice of airlines?
- Do passengers really appreciate IFE?
- Does IFE increase passengers' loyalty?
- Does IFE have a revenue generating potential?
- Are passengers prepared to pay for IFE?, and, if so, how much?
- What about the reliability of IFE systems and its impact on passengers?
- What are the implications of not having an IFE?
- What about the future role of IFE in airlines' product plan?

This paper addresses the above questions based on a passenger survey carried out in the UK in summer of 1998 and extensive literature survey on the subject. Unlike most other literature on the subject, the paper reflects passenger views on IFE rather than airline or supplier views. As mentioned in the Inflight Annual Handbook (1999), it is not very clear whether the technology is driving the demand for the systems, or demand dictating the technology in the area of IFE development.

To address the above questions, the paper is divided into three parts. The first part provides a brief overview of current IFE systems, the second or the main body of the paper analyses the passenger survey results, and finally in the third part conclusions are drawn about the role of IFE in airline product design.

2 Current in-flight Entertainment Systems

Entertaining passengers, especially on long haul flights, is not a new concept. As there are some evidence that IFE, in 1930s, included live singers, musicians and fashion shows (Kelly, 1999). However the technological revolution in IFE has taken place in the last decade. With the arrival of miniature TV screens in the consumer market, the idea of providing them the during the flight was initiated. The first personal screen video system was tested on a Northwest Airlines' Boeing 747 in June 1988. The pioneering airlines in providing personal IFE tend to offer these services in their first and business class cabins. However Emirates was the first airline to offer IFE in all passenger classes in 1992. Virgin Atlantic and Singapore Airlines also provide personal IFE in all their cabins.

The current IFE systems include screen based, audio and communication systems. The **screen based** products include *video systems* enabling passengers watching movies, news and sports. This system has progressed into *video-on-demand*, allowing passengers to control when they watch the movies. *Air map display* is another product, allowing passengers to locate their flight en route. *Exterior-view cameras* also enable passengers to have the pilot's forward view on take-off and landing on their personal TV screens. Other screen-based facilities includes *gambling*, *computer games*, *destination information*, *financial services*, and *shopping catalogues*.

Audio systems includes different types of *music channels* and special programmes recorded for the airlines, such as interviews with public figures, authors and celebraties.

Communication systems includes mainly business facilities such as *telephones*, *facsimile* and *in-seat power supplies*.

The IFE suppliers and manufacturers are continuously working on developing new systems. Most recent developments includes the provision of the digital versatile disk (DVD), which would improve picture, sound quality and provide greater capacity and durability, compared with tapes. This system is supposed to be more reliable, compact and lighter than traditional tape players (Flight international, 1999). For more information in relation to future technological development in IFE systems see Whelan, 1999.

One of the key factors in provision of IFE is the reliability of the systems. In mid 1990, airlines experienced serious reliability problems with the systems. Currently, the suppliers of the systems offer 98% reliability which means on average the remaining 2% passengers would have a problem with their IFE system. This could mount to a relatively large number of unhappy passengers on a wide body jet aircraft carrying 400 people, over a period of time.

Having highlighted the current products offered by airlines in their IFE programme, the next chapter discusses passengers perception of such systems.

3 The Passenger Survey

A sample of 100 passengers were surveyed by means of postal questionnaires and interviews. The questionnaire was designed to establish the passengers' travel behaviour and their experience with current IFE products and services.

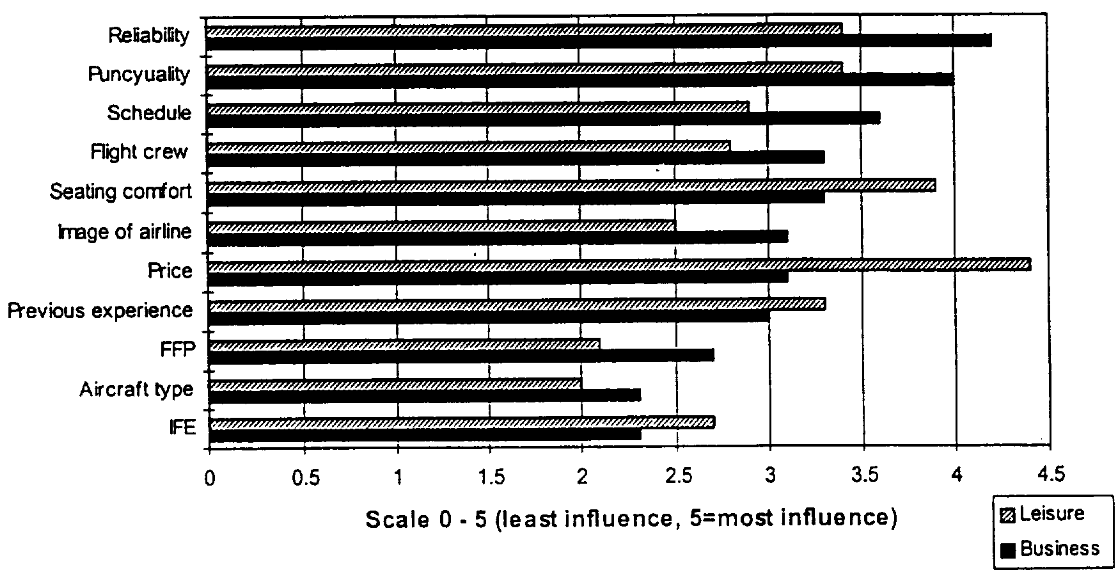
The rest of this section discusses the results of the survey in order to address the questions raised in Section 1, by focusing on three most important areas discussed above:

3.1 Passenger perceptions of IFE

As discussed in Section 1, one of the objectives of providing a service or product is to meet the customer needs. In that context it was important to establish to what extent IFE affects a passenger's choice of airline.

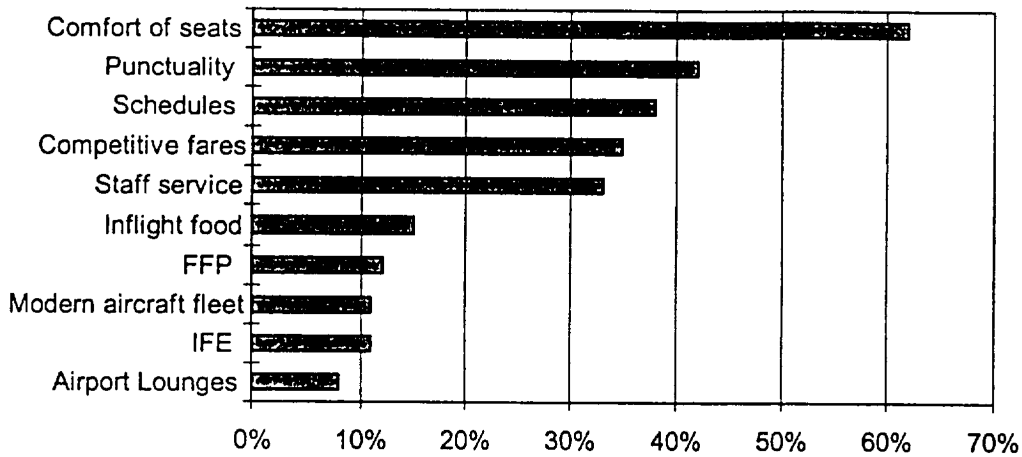
The results of the survey indicated that, while the most influential factors affecting business passengers were reliability, punctuality, seating comfort and schedules, for leisure passengers price was the most important factor. Although IFE was one of the amongst factors influencing the choice of passengers it was not regarded as one of the most important ones (Figure 1).

Figure 1: Factors Influencing Passengers Choice of Airline



The findings were very much in line with the IATA's Corporate Air Travellers Survey illustrated in Figure 2. As shown, IFE does not feature as a strong influencing factor amongst other factors.

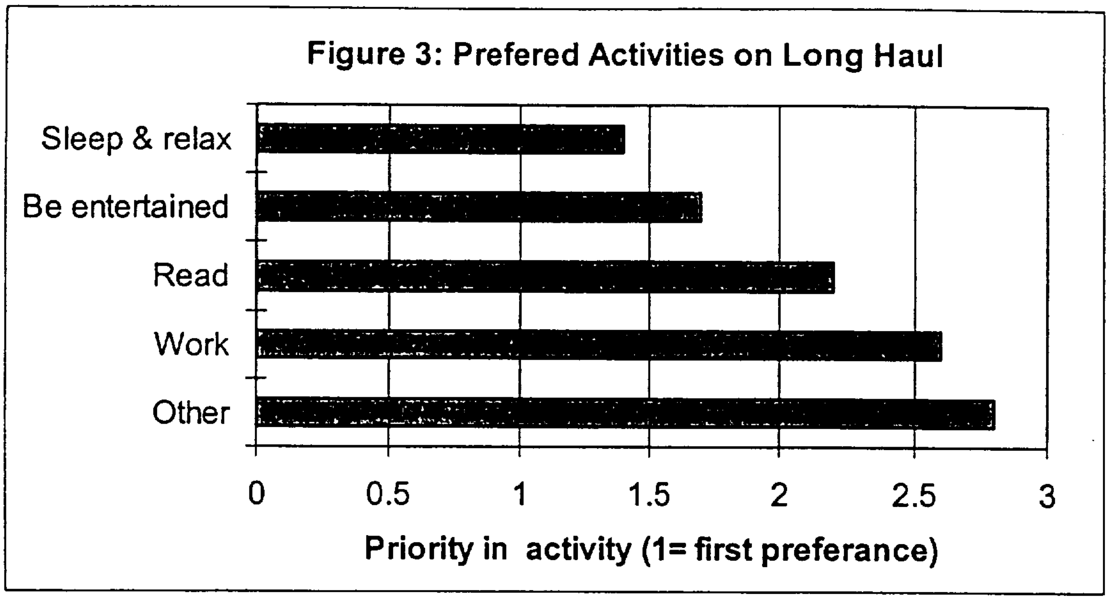
Figure 2: Important Aspects of the Long Haul Business Product



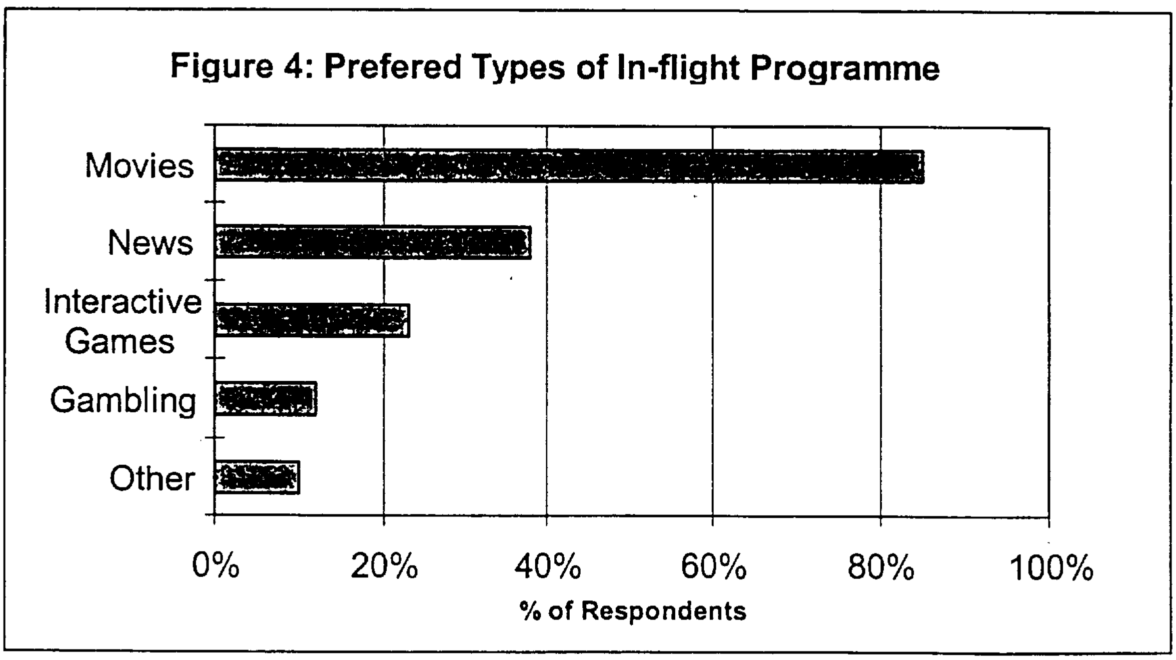
IATA Corporate Air Travel Survey, **% of Respondents**

A similar survey, carried out by SPAFAX Consulting for both business and economy class passengers, also gives IFE a lower priority in factors affecting airline choice (PIER, 1998). Clearly it is hard to imagine that passengers would give a high priority to provision of IFE in their choice of carrier. If everything is equal, perhaps IFE could play a role to tip the balance towards a competing carrier with such systems.

Sometimes it is argued that what passengers actually state as their preferences are not the same as their revealed preferences. In other words, passengers may enjoy IFE but when their opinion is sought about it, they give it a low priority. To establish whether passengers actually regard IFE as an important in-flight product feature on long haul flights, they were asked about their most preferred activities during the flights. The results are illustrated in Figure 3. As can be seen, relaxing is the most preferred activity. This is in line with an American Express survey, 1999, which indicated that 54% of business passengers like to relax while flying while 26% work during the flight. The most preferred activity after relaxing and sleeping was being entertained. The result is in line with the trend in public attitude towards entertainment. The entertainment industry is amongst the fastest growing industries. Therefore, it is not unrealistic to assume that people not only like to be entertained on the ground but also in the air, especially during long haul flights. Being entertained in economy class during long flights is even more important. This is due to seat configuration in most airlines' economy class cabin which makes it difficult to sleep or relax.



When the respondents were asked what is their most preferred type of in-flight programme, movies were ranked by over 80 percent of passengers as the most popular one. This explains the trend in airlines offering of up to 22 video channels, with an average of 52 film titles per year on screens of up to 36cm in size. Singapore Airlines offers the largest TV screen in the industry in their first class.



The preference for various IFE features were recorded in an IATA survey of business passengers As can be seen in Table 2, power sockets for computers, e-mail and internet are given priority. To ensure that the business passengers survey of most desirable IFE facilities is in line with what they really prefer, airlines can assign a small number of their cabin crew to pay special attention to business passengers behaviour in relation to their

activities during flights . There is some anecdotal evidence that while business passengers state that they would like all the business facilities possible in the air, in reality they prefer to relax and watch movies. Therefore, it would be very useful to compare their stated preference with their revealed preference in a systematic and structured way.

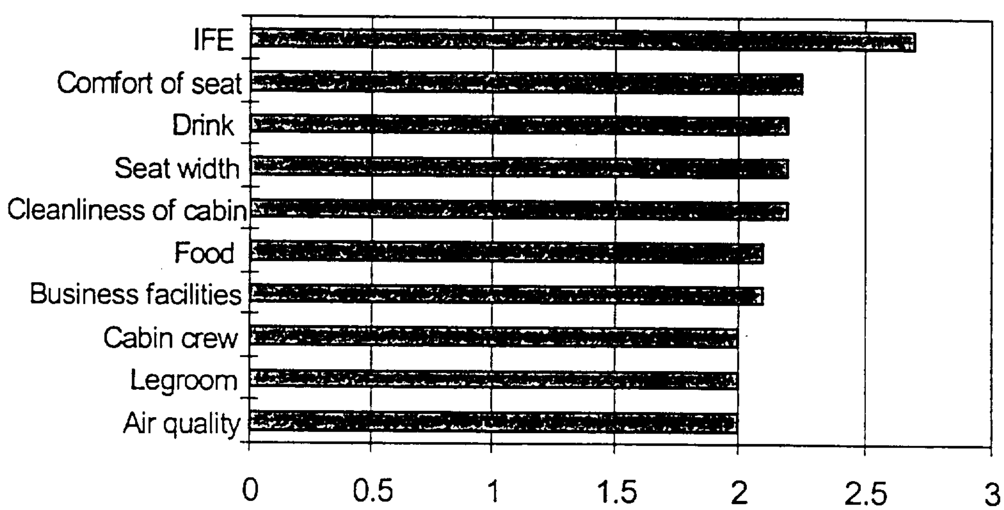
Table 2: Most Desirable IFE Facilities

Facilities (0=not interested, 5=very interested)	Mean Score
Power sockets for computers	3.59
E-mail	3.23
Internet	3.09
In-flight Phone	3.06
In-flight fax	2.80
Live TV	2.74
On-line connection to database	2.66
On-line reservation to car hire, connecting flights	2.44
Live Radio	2.04
Catalogue Shopping	1.12
Gambling	0.77

IATA Corporate Air Travel Survey, 1997 data

The respondents were also asked which aspects they felt were improved most amongst all the in-flight products, in recent years. The results are summarised in Figure 5. It could be seen that IFE was perceived by passengers as the most improved feature of in-flight products.

Figure 5: Passengers' Perception of In-Flight Product



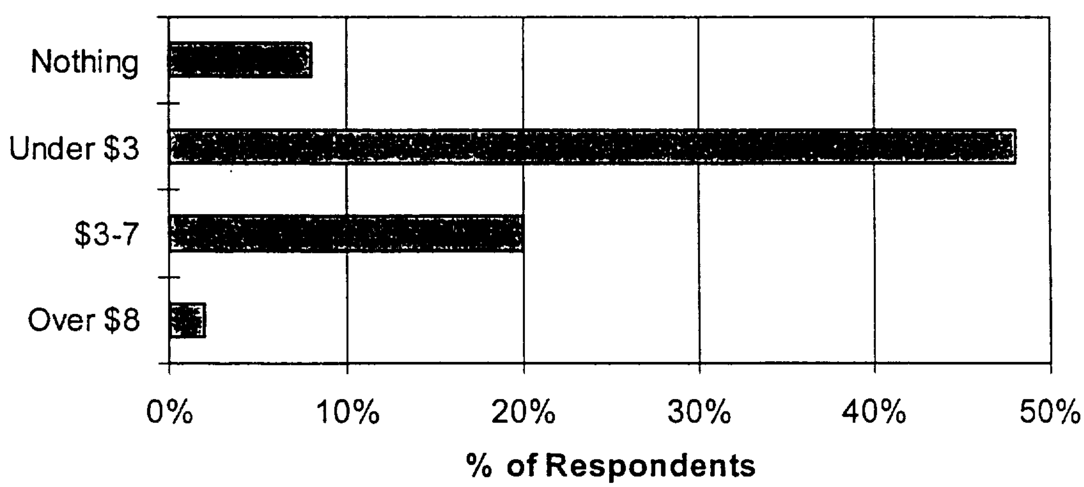
The results of passenger perception of IFE indicates that while IFE is not one of the crucial factors affecting their choice of airlines, they appreciate it during the long haul

flights. Also IFE appears to be addressing passengers' needs in relation to their preference for relaxing and being entertained during long haul flights,

3.2 Passengers' willingness to pay for IFE services

As stated in section 1, the second objective of provision of any products or services is to meet shareholders requirements which is generating sufficient revenue not only to cover costs but to generate additional profit. In order to establish whether IFE has the potential to generate revenue from passengers, the respondent were asked if they were prepared to pay to watch movies. Movies were felt to be the programme with most potential to generate revenue, as it was the most preferred IFE programme by the passengers (see Figure 4). The majority stated that they are prepared to pay to watch a movie. While nearly 50% of respondents were happy to pay under \$3, only 20% stated they would pay between \$3 to \$7. Based on the cost of installing IFE and the fact that they are written off over a period of 3 to 5 years (as discussed in Section 1), unless the majority of passengers are prepared to pay more than \$3, the scheme could actually increase the costs to airlines due to need for the collection of money and the required administration. Swissair for example recently experimented with a charge for movies, but with limited success.

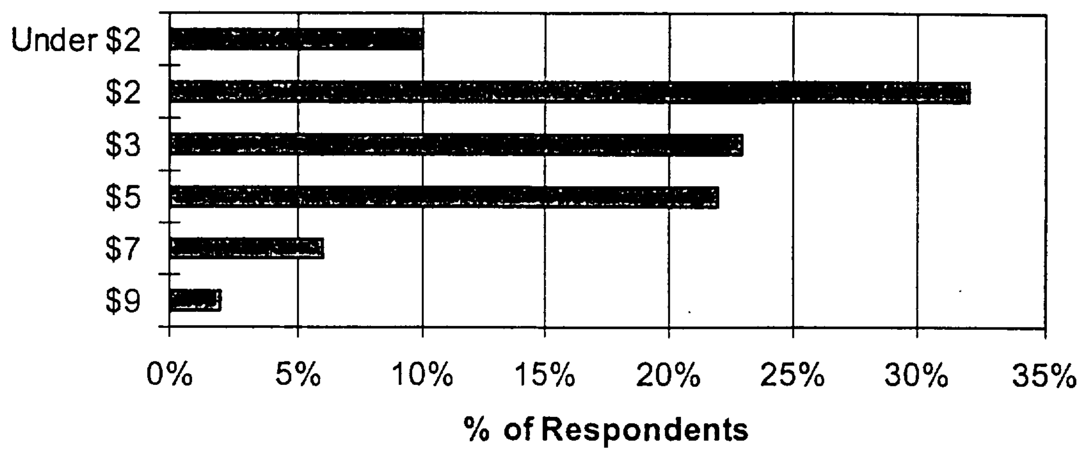
Figure 6: Passengers' Willingness to Pay for Movies



Respondents were also asked if they consider \$10 per minute as a reasonable charge for a telephone call on-board an aircraft. Almost 80% of passengers stated that it is not a reasonable charge, the rest felt it is reasonable only in an emergency. When they were asked what is a fair charge, it appeared that \$2 to \$3 is what the majority were prepared to pay per minute. It appears that, by lowering the call charges, more passengers will use the telephone for a longer period of time. This would be very much in line with people's behaviour in relation to the usage of mobile phones on the ground. As the price of call by mobile phones dropped over the past years, its usage increased greatly to the extent that a

large proportion of population in developed and even developing countries have a mobile phones. Therefore, it is not surprising that JetPhone has reduced it telephone charges for Air France's passengers towards the end of 1998. It introduced a simplified pricing structure by charging for domestic calls 10FF per minute, 20FF for European calls and 30FF per minutes for the rest of the world (Inflight, March 1999).

Figure 7: Reasonable Telephone Charge per Minute



The results of the survey with regard to the revenue generation potential of IFE for two most popular IFE products, movies and telephones, indicates that it cannot be considered as a source of revenue to the extent to cover the full costs of the system, including a profit. Although it has been mentioned that advertising and gambling could have a better potential for generating revenue, gambling does not appear to be very popular amongst a large proportion of passengers (see Table 2).

3.3 The role of IFE as a differentiating tool

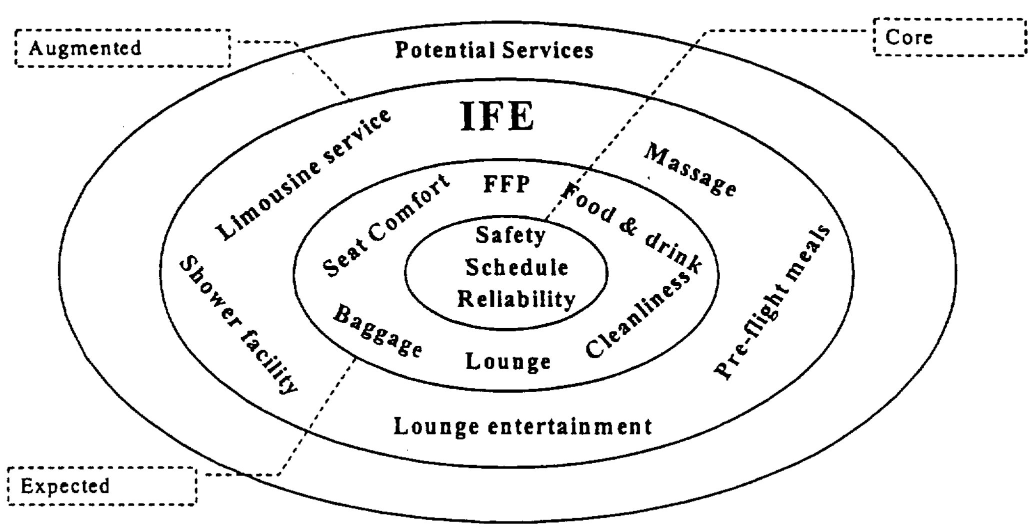
The third objective of any product provisions, as stated in Section 1, is to out-perform the competitors. Currently there are three groups of airlines in relation to their attitude to the provision of IFE. One group consist of those airlines which consider IFE as a very strong differentiating tool. These airlines have invested heavily in such systems. A prime example would be Singapore Airlines which has been nominated as the best provider of IFE in the industry (World Business Class Survey, 1998). SIA's most recent development in their IFE, called Kris World, includes the provision of cinema quality sound with standard stereo headphones (Outlook, 1999). Other carriers which have used IFE to differentiate their products from the competition include Emirate Airlines, Virgin Atlantic, Malaysian Airlines, Swissair and Lauda Air.

Another group of airlines consists of carriers that are undecided about the strength of IFE as an effective differentiating factor.

The third group of airlines includes those that are currently focusing on other areas of product provision to catch-up with more progressive airlines. Therefore, IFE is by no means on the top of their list of product development or improvements.

In order to address the question of IFE as product differentiator, one needs to establish the position of IFE on passengers' map of airline product features. To do so, airline products are divided into four categories of core, expected, augmented and potential features. Core product consist of those element of airline service which make the organisation an airline such as aircraft type, schedules and a safe and reliable transport of passengers. Expected products are those product features that are additional to the core product, and almost all traditional airlines provide them, such as provision of food and drink during the flights. Expected products are those features that add value to passengers and are beyond passengers' expectation. These are those features that are provided by a number of airlines and used as differentiating factors. Potential products are those product features which are currently planned for future provision such as shower room on board, gym, etc. As illustrated in Figure 6, IFE could currently be placed in the augmented part of airline products. This is because there are a large number of airlines that do not offer IFE, especially in economy class.

Figure 8: Position of IFE on Passengers' Map of Airline Product



As the number of airlines offering such systems increases the position of IFE in passengers map of airline product moves towards the expected product features. Therefore it could be said that IFE is currently a product differentiator. As mentioned in Section 1, the reliability of the systems is very important. When the systems do not perform as expected it can in fact create a negative image in passengers mind. A flight

can become very unpleasant when passengers with faulty personal IFE system see fellow passengers are enjoying different programmes offered by the system.

In the future, as stated by marketing director of British Airways (WAEA, 1999), the industry will face competition in the area of quality and range of IFE as opposed to just the provision of the system. It is also very likely that the provision of personal IFE be used as a differentiating factor in medium haul flights of between 4 to 7 hours.

4 Conclusions

Based on the passenger survey and other literature on the subject the following conclusions are drawn on the questions raised in Section 1.

- IFE is not a primary factor affecting passenger choice of airlines. However, passengers appreciate the provision of IFE, especially on long haul flights. Provision of IFE will meet passengers' needs to relax and be entertained during long haul flights.

- IFE enhances the airline service, image and brand. Of course it is not a substitute for poor services in other areas of an airline's product plan. However, if the airline core product, namely, the transport of passengers in a reliable, efficient and safe manner meets customer satisfaction, the provision of IFE could enhance the airlines' image.

- Although passengers increasingly appreciate the provision of IFE during long haul flights, they do not appear to be prepared to pay for it to the extent to cover the full costs of the systems. More over, since many airlines do not charge their passengers for IFE, it is increasingly hard for others to introduce charges.

- IFE currently provides product differentiation; however, in the future it will become part of expected product features in all classes. In that case the question in relation to IFE would not be about how much revenue it generates but how much revenue would be lost due to the lack of IFE.

- The key issues in relation to IFE are its reliability, simplicity of its operation by passengers and availability on all aircraft fleets to the chosen destinations. Unreliable IFE can damage the image of an airline, and create a poor perception in passengers' mind.

The technology will certainly drive the demand for IFE. The introduction of the digital versatile disk (DVD) is an example in the case. The majority of airlines will eventually install personal IFE in their aircraft. While, currently, the airlines with advance IFE can reap the benefit of having such systems, in the future the differentiation will come from the quality and the range of services offered by IFE systems.

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STATISTICAL APPROACH FOR EVALUATION OF AIRPORT PAVEMENT FUNCTIONAL LIFE.

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ABSTRACT: The paper covers procedure for predicting of concrete airport pavements functional life reflecting statistical properties of design variables.

1. INTRODUCTION

According to the Construction Rules (1) concrete pavements are designed to adequately serve a predicted number of load applications for twenty years prescribed design life at the lowest possible initial and maintenance costs. Analysis of concrete pavements performance show that real serviceability age at civilian airports of Russian Federation differ from 3 to 30 years. Construction rules (1) reflect only a realistic degree of variation in flexural strength of concrete and do ignore stochastic nature of other main variables: gross aircraft mass, slab thickness, elastic modulus of concrete, coefficient of subgrade reaction, number of load applications expected from specific volume of mixed traffic and its distribution pattern.

Procedure proposed here was developed from a study and correlation of deterministic design methodology (1) existing plate theory on bending moments in concrete pavements due to loads and warping, gypothethis of Miner, fatigue concept and theory of stochastic functions.

EXISTING PRACTICE

Deterministic design procedure include comparison of bending moments caused by aircraft loads at the outside edge of a concrete pavement and ultimate bending moment for given slab thickness using the following equation.

$$m_d \leq m_u \tag{1}$$

where m_d – bending moment in concrete slab caused by the design aircraft main gear arrangement at the outside edge of slab

$$m_d = m_c \cdot k \tag{2}$$

m_c - bending moment in concrete slab caused by design aircraft main gear wheels at the interior of the slab;

k - factor to convert bending moment increase at the outside edge;

m_u - ultimate bending moment for given slab thickness, flexural strength of concrete at design age and number of load repetitions

$$m_u = \gamma_c \cdot R_{btb} \cdot k_u \tag{3}$$

γ_c - factor to convert concrete strength increase with age and warping stresses;
R_{btb} - design modulus of rupture;
K_u - load repetition factor to reflect fatigue effect in concrete under repeated loading.

FATIGUE CONCEPT

Flexural fatigue research show that under continued repetitions of loads failure of concrete beams occurs at stresses ratios of less than unity. Flexural fatigue of concrete is reflected in construction rules (1) methology by selection of load repetition factor K_u based on number of the heaviest aircraft undercarriage wheel passes expected during the pavement design life

$$K_u = 2 - \frac{\lg U_d}{6} \tag{4}$$

where U_d - expected number of the heaviest aircraft main gear wheel load applications for design age of the pavement.

It should be noted that equation (4) corresponds with PCA fatigue research results published in 1973 (2) and may be expressed as follow.

$$K_u = \frac{\gamma(N)}{\gamma(N = 1 \cdot 10^6)} = \frac{\gamma(N}{0,5} \tag{5}$$

where γ (N_i) – stress ratio

$$\gamma(N) = \frac{\sigma_{N_i}}{R} = 1 - \frac{\lg N}{12} \tag{6}$$

σ_{N_i} – repetitive stress;
R - mean flexural strength of concrete;
N - number of repetitions to cause concrete flexural fatigue failure.
$\gamma(N = 1 \cdot 10^6)$ - stress ratio permitting $1 \cdot 10^6$ repetitions without loss in fatigue resistance.

From equation (6) one can calculate number of repetitions N_i to cause flexural rupture under stress σ_{N_i}

$$N_{\sigma_{N_i}} = 10^{[1-\gamma(N_i)]} \qquad (7)$$

Under real pavement performance conditions stress ratio γ (N_i) of concrete depends on stochastic nature of design variables which effect on the bending moments in slab.

STATISTICAL APPROACH

The effect of variability of design factors may be introduced in (7) as follows

$$N_{\sigma_{N_i}} = 10^{12\left[1-\frac{\overline{M_f}+\overline{M_t}}{K_p \overline{M_u}}\right]} \qquad (8)$$

Where M_f – average bending moment in concrete stab caused by the heaviest aircraft main gear arrangement;

M_t - average bending moment due to temperature gradient on the top and the bottom surfaces of slab;

M_u - average ultimate bending moment computed for given slab thickness and design modulus of rupture of concrete;

K_p - statistical coefficient to account combined harmfull effect of variability of wheel loads, number of applications, flexural strength and modulus of elasticity of concrete, modulus of subgrade reaction, thickness of slab and surface pavement temperature amplitude (3)

$$K_p = \frac{1-\sqrt{1-\left\{\left[1-z_p^2\frac{D_{M_f}+D_{M_t}}{\left(\overline{M}_f+\overline{M}_t\right)^2}\right]\cdot\left[1-z_p^2 V_{M_u}\right]\right\}}}{1-z_p^2\cdot V_{M_u}} \qquad (9)$$

Z_p – standardized normal variant for P level of pavement reliability;
D_{Mf} – variance of bending moment caused by designed gear load.

$$D_{M_f} = \left(\frac{\partial M_f}{\partial F_d}\right)^2 \cdot S_{F_d}^2 + \left(\frac{\partial M_f}{\partial E_B}\right)^2 \cdot S_{E_B}^2 + \left(\frac{\partial M_f}{\partial h}\right)^2 \cdot S_h^2 + \left(\frac{\partial M_f}{\partial K_s}\right)^2 \cdot S_{K_s}^2 \tag{10}$$

$$D_{M_t} = \left(\frac{\partial M_t}{\partial h}\right)^2 \cdot S_h^2 + \left(\frac{\partial M_t}{\partial E_B}\right) \cdot S_{E_B}^2 + \left(\frac{\partial M_t}{\partial A}\right)^2 \cdot S_A^2, \tag{11}$$

$$V_{M_u} = \frac{\sqrt{D_{M_u}}}{\overline{M}_u} \tag{12}$$

$$D_{M_u} = \left(\frac{\partial M_u}{\partial K}\right)^2 \cdot S_R^2 + \left(\frac{\partial M_u}{\partial h}\right)^2 \cdot S_h^2 + \left(\frac{\partial M_u}{\partial u}\right)^2 \cdot S_u^2 \tag{13}$$

S_{Fd}, S_{Eb}, S_h, S_{Ks}, S_A, S_R, S_u – standard deviations of wheel load, modulus elasticity of concrete, slab thickness, modulus of subgrade reaction, amplitude of temperature, flexural strength of concrete and number of loading;

$\frac{\partial M}{\partial}$ - first partial derivative of stochastic function of bending moments with respect to the means of random variables: wheel load F_d, modulus of elasticity of concrete E_b, thickness of slab h, coefficient of subgrade reaction K_s, amplitude of pavement surface temperature A, flexural strength of concrete R and number of load applications U

$$\frac{\partial M_f}{\partial F_d} = 0{,}018306\sqrt{P_a / \overline{F_d}^3} \cdot \sqrt[4]{\overline{E_b}\,\overline{h}^3 / \overline{k_s}} \tag{14}$$

$$\frac{\partial M_f}{\partial E_b} = 0{,}001749 \sqrt{\overline{h}^3 / \overline{k_s} \cdot \overline{E_b}^3} - 0{,}013745 \sqrt[4]{\overline{h}^3 / \overline{k_s}\,E_b^7} \tag{15}$$

$$\frac{\partial M_f}{\partial h} = 0{,}013745\sqrt{P_a \cdot \overline{F_d}} \cdot \sqrt[4]{\overline{E_b} / \overline{h}^5 \overline{k_s}} + \\ + 0{,}005248 P_a \sqrt{\overline{E_b} / \overline{h} \cdot \overline{k_s}} \tag{16}$$

$$\frac{\partial M_f}{\partial k_s} = 0{,}022908 \sqrt{P_a \cdot \overline{F_d}} \cdot \sqrt[4]{\overline{E_b} t^3 / \overline{k_s}^9} - \\ - 0{,}005247 \; P_a \sqrt{\overline{E_b}\, \overline{h}^3 / \overline{k_s}^5} \tag{17}$$

$$\frac{\partial M_t}{\partial h} = 0{,}0874 \alpha \overline{h} \overline{E_b} \overline{A} \tag{18}$$

$$\frac{\partial M_t}{\partial E_b} = 0{,}0437 \, \alpha \overline{h}^2 \cdot \overline{} \tag{19}$$

$$\frac{\partial M_t}{\partial A} = 0{,}0437 \, \alpha \overline{h}^2 \cdot \overline{E}_b \tag{20}$$

$$\frac{\partial M_u}{\partial R} = \alpha_1 \overline{h}^2 \left(2 - lg \overline{U} / 6\right) \tag{21}$$

$$\frac{\partial M_u}{\partial h} = 2\alpha_1 \overline{R} \cdot \overline{h} \left(2 - lg \overline{U} / 6\right) \tag{22}$$

$$\frac{\partial M_u}{\partial U} = -0{,}0724 \, \alpha_1 \overline{R} \cdot \overline{h}^2 \; / \overline{U} \tag{23}$$

α_1 – coefficient to convert concrete flexural strength increase with age.

Detrimental effect D caused by load applications N_i may be calculated by formula

$$D = \frac{1}{N_{\sigma_{N_i}}} = \frac{1}{10^{12\left(1-\frac{\overline{M_f}+\overline{M_t}}{k_p \overline{M_u}}\right)}} \tag{24}$$

Summary detrimental effect D under special aircraft traffic mix pattern expressed by Miner's law

$$\sum_{i=1}^{k} \frac{N_{\sigma_i}}{N_{\sigma_{N_i}}} = 1 \tag{25}$$

where $N_{\sigma i}$ – number of stress repetitions at outside edge of slab for a specific aircraft main undercarriage wheels for the design life

$$N_{\sigma_i} = n(365 - T_f)k_{n_i} \cdot n_o \cdot U_i \cdot P_i(x \tag{26}$$

Where n – pavement functional life;

T_f – number of days in the year when subgrade is in frozen condition.

K_{ni} - coefficient to convert the effect of particular aircraft landing gear to the effect of landing gear of design aircraft;

n_o - number of tandem gears;

U_i - number of daily departures of particular aircraft;

$P_i(x)$ - probability to account transverse distribution of particular aircraft main gear loading, FIG.1;

$$P_i(x) = P(x_1 \le x \le x_2) = \int_{x_1}^{x_2} f\left(x, \overline{x_i}, S_{x_i}\right) \tag{27}$$

$$f\left(x,\overline{x_i},S_{x_i}\right)=\frac{1}{S_{x_i}\sqrt{2n}}e^{-\frac{x-\overline{x_i}^{2}}{2S_{x_i}^{2}}} \qquad (28)$$

$$\left.\begin{aligned} x_1 &= x-\frac{b}{2} \\ x_2 &= x+\frac{b}{2} \end{aligned}\right\} \qquad (29)$$

where $f\left(x,\overline{x_i},S_{x_i}\right)$ - normal distribution function;

x_i and S_{xi} – mean and standard deviation of aircraft wheel-paths from pavement centerline or guideline marking;

x - distance from longitudinal axis (centerline or guideline marking) of pavement to design section of slab, where load repetitions are determined;

b - design traffic width

$$b = d + 2R_i \qquad (30)$$

d - distance between centers of contact areas of dual wheels;

R_i- radius of main undercarriage wheel contact area for specific aircraft

$$R_i = \sqrt{\frac{F_{d_i}}{\pi \cdot P_a}} \qquad (31)$$

$$F_{d_i} = \frac{\overline{M}_i \cdot g \cdot k_m}{n_m \cdot n_w} \cdot k_d \cdot \gamma_f \tag{32}$$

F_{di} – wheel load for specific aircraft;
M – average take-off mass for specific aircraft;
g – acceleration of gravity;
K_m – portion of the main legs loads;
K_d – coefficient to reflect load application impact;
γ_f - coefficient to reflect wings lift;
n_m - number of main undercarriage legs;
n_w - number of wheels in main leg undercarriage assembly.

As an example probabilities $P_i(x)$ calculated by formulas (27)-(32) for specific aircraft are presented in figure 2.

Substitution formulas (24) and (26) to (25) gives following equation to determine airport concrete pavement functional life

$$n = 10^{12\left[1-\frac{\overline{M}_f+\overline{M}_t}{K_p M_u}\right]} \Big/ 365\sum_{i=1}^{k} k_{n_i} n_{o_i} u_i \cdot P_i(x) \tag{33}$$

Proposed equation allows more precisely evaluate: number of load applications expected during pavement life from specific volume of mixed traffic, its distribution pattern, variability of gross aircraft mass, flexural strength and elastic modulus of concrete, coefficient of subgrade reaction, slab thickness, amplitude of surface pavement temperature, number of stress repetitions and given reliability level of pavement structure.

NUMERICAL ANALYSIS

To investigate the influence of statistical variability of design parameters and given probability level on the concrete pavement functional life numerical analysis was performed under following conditions:

- concrete slab thickness $\overline{h} = 0{,}30$;

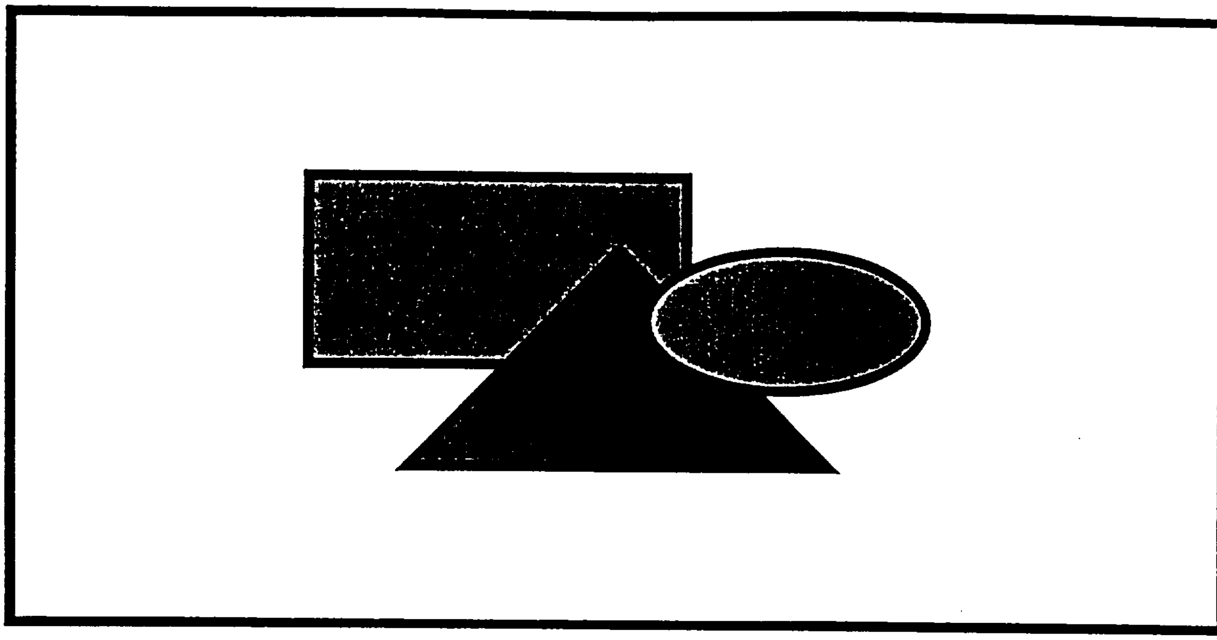
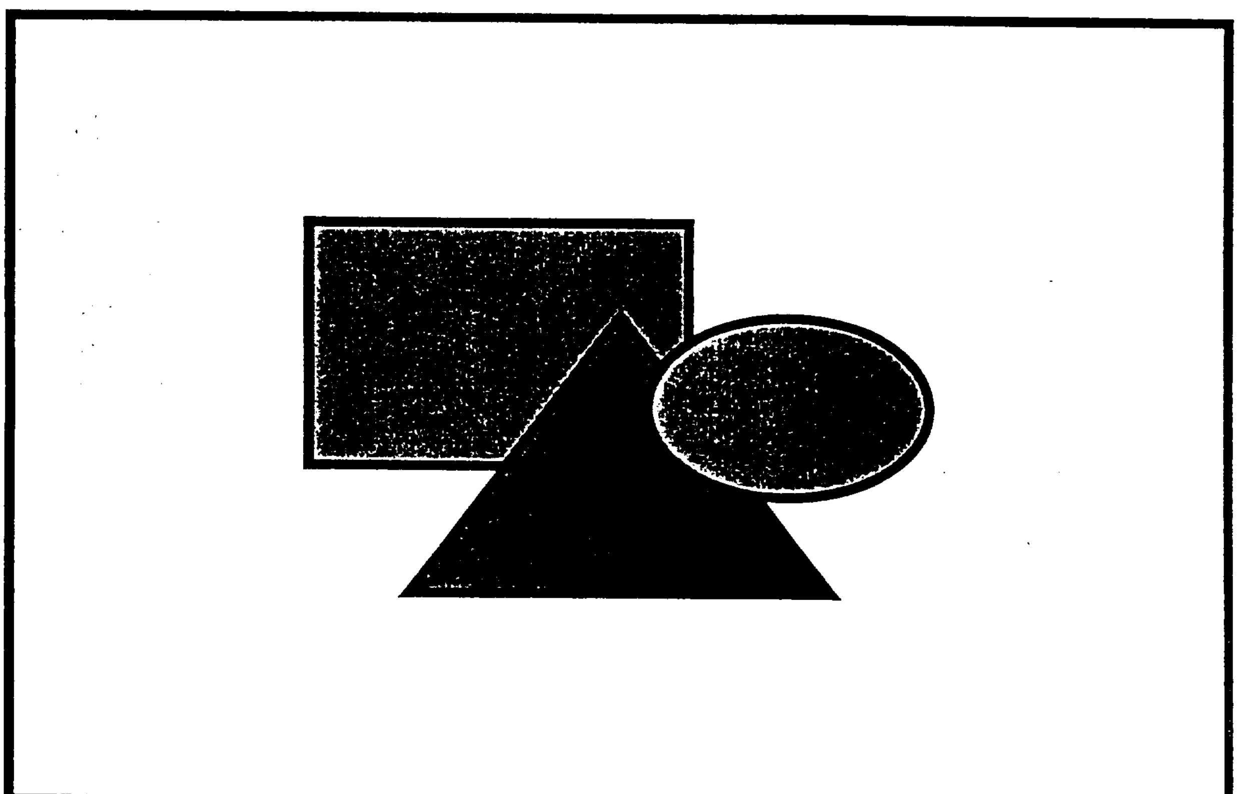


FIG. 1. Lateral distribution of aircraft wheel-paths: B_{TW} - track width; B_P - pavement width; B_c – width of shoulder



Distance from pavement centerline or guideline marking.

FIG. 2. Probabilities [illegible] distribution curves for particular aircraft

- coefficient of variation of slab thickness V_h =0,10;
- average flexural strength of concrete $\overline{R}$=5,13 p ; coefficient of variation of concrete flexural strength V_R =0,135;
- average modulus elasticity of concrete $\overline{E_b}$ =3,24·10[4] p ; coefficient of variation of modulus of elasticity of concrete V_E =0,135;
- average coefficient of subgrade reaction $\overline{K_s}$ = 51,6 / ³; coefficient of subgrade reaction V_{K_S} =0,30;
- average amplitude of concrete surface pavement temperature =7,55 °C; coefficient of variation of amplitude V_A=0,33;
- designed aircraft type – -86; average take-off mass $\overline{M}$ =206 t; coefficient of take-off mass variation V_M=0,05;
- average daily number of take- off $\overline{U_i}$=60; coefficient of daily take off number variation V_u=0,10;
- number of tandem axes – 2;
- maximum probability of main wheels passes $P_i(x$ =0,83, FIG. 2.

Values of statistical coefficient K_p calculated by formulas (9) – (23) by computer program are given in Table 1.

Table 1. Statistical coefficient K_p

Given probability level	0,5	0,6	0,7	0,8	0,9	0,95
Statistical coefficient K_p	1,0	0,95	0,90	0,84	0,77	0,72

The results of numerical analysis are illustrated in FIG.3.

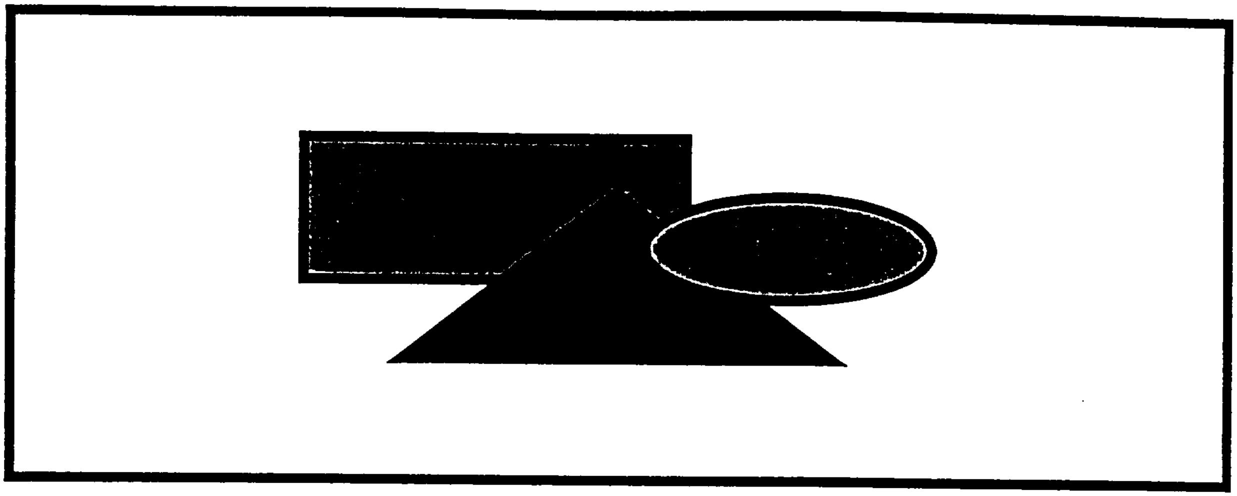


FIG.3. Predicted concrete pavement life age as function of stress ratio $\gamma(N$ and given probability level P

As given probability P level and stress ratio $\gamma(N)$ increase functional concrete pavement life decrease. The higher given probability level the lower functional life of pavement at constant stress ratio $\gamma(N$. At stress ratio value $\gamma(N$ =0,5 and given probability level $P = 0{,}95$ predicted functional pavement life is 15 years. As stress ratio $\gamma(N$ increases to 0,65 predicted functional life of concrete pavement downwards to three and a half years.

CONCLUSION

It is shown that functional life of concrete pavements depends on statistical variability of mechanical properties of materials, aircraft traffic mix loads and environmental condition. That is why to predict pavement service life till cracking of concrete due to fatigue consumption will take place can be implemented only with certain probability. Procedure proposed in this paper is may be considered as first step towards statistical approach in that direction. The results of that approach also underline the significance of quality control and statistical evaluations of test data of construction materials used for a particular airport pavement's project. The use of statistical approach provides more realistic data to the cost estimator for a new particular project or pavement overlay design. Probability distribution pattern for different traffic mix (FIG.2) and statistical coefficient values, calculated for various regions of Russian Federation are proposed for adjustment to aerodrome's construction rules to overcome shortcomings of existing deterministic methodology.

It is important to note that functional pavement life define the moment of initial process of cracking caused by stress repetitions in a critical traffic width where the probability of design aircraft main leg wheels passes is maximum. That is why proposed procedure requires modification to reflect cracking propagation in concrete slabs after initial cracks have developed. Also it is of interest to compare numerical value of functional life received by statistical approach to real serviceability age of concrete pavements designed by conventional deterministic methodology. Statistical analysis have shown that average serviceability age of concrete pavements in Russian Federation airports is 11 years. That result has a good compromise with statistical approach at desired probability level $P = 0{,}95$.

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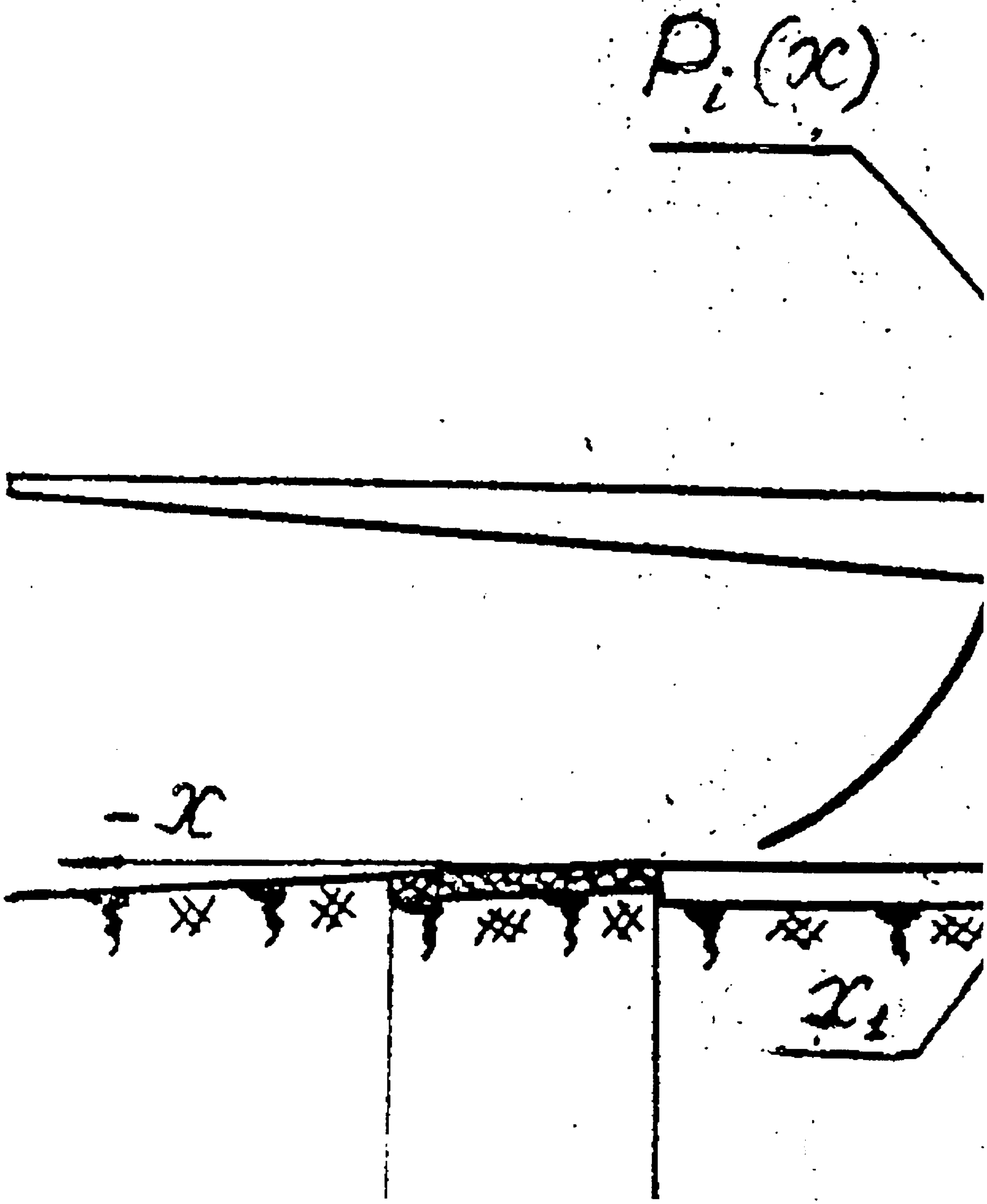
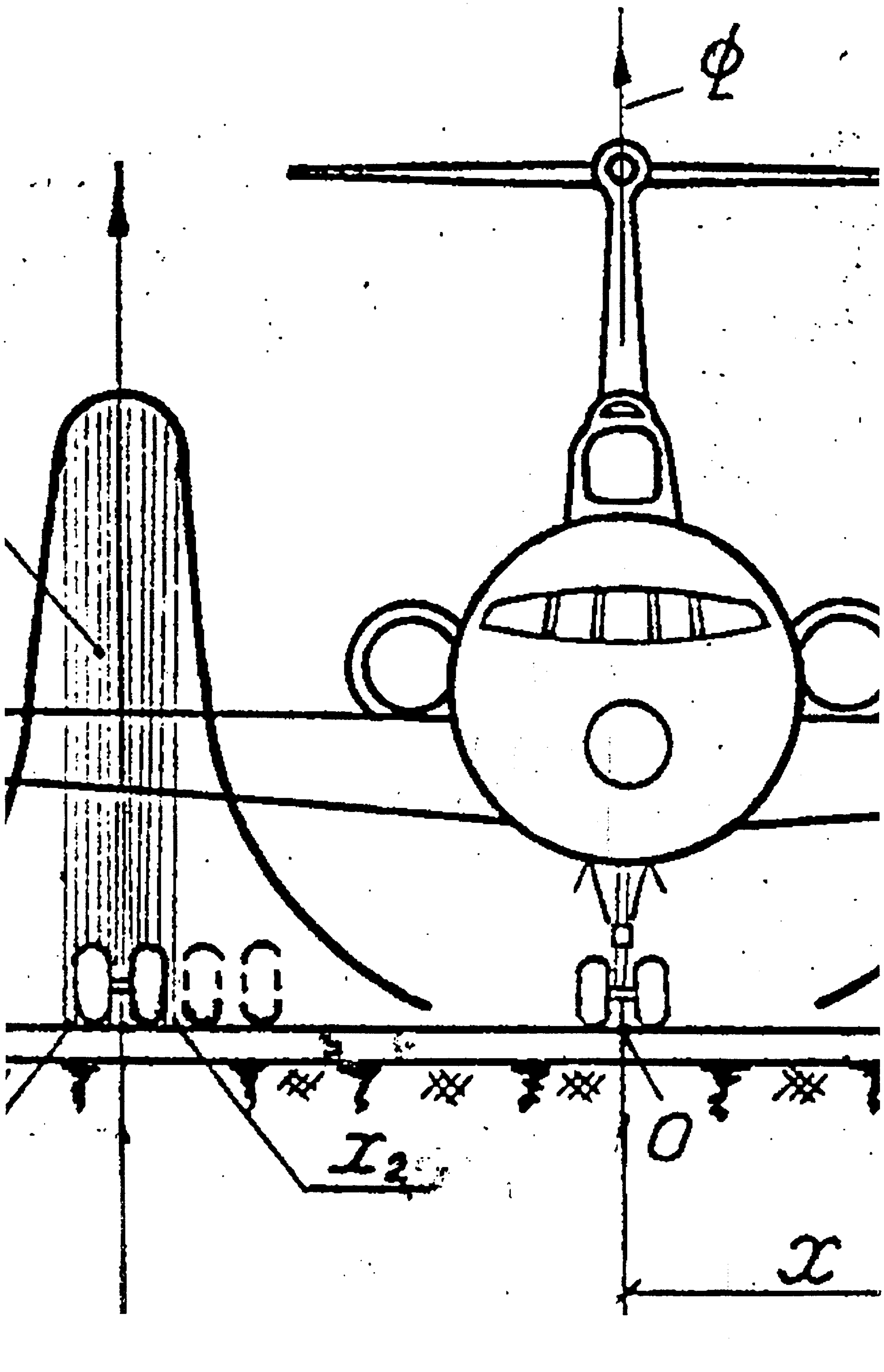


$P_i(x)$
$-x$
x_1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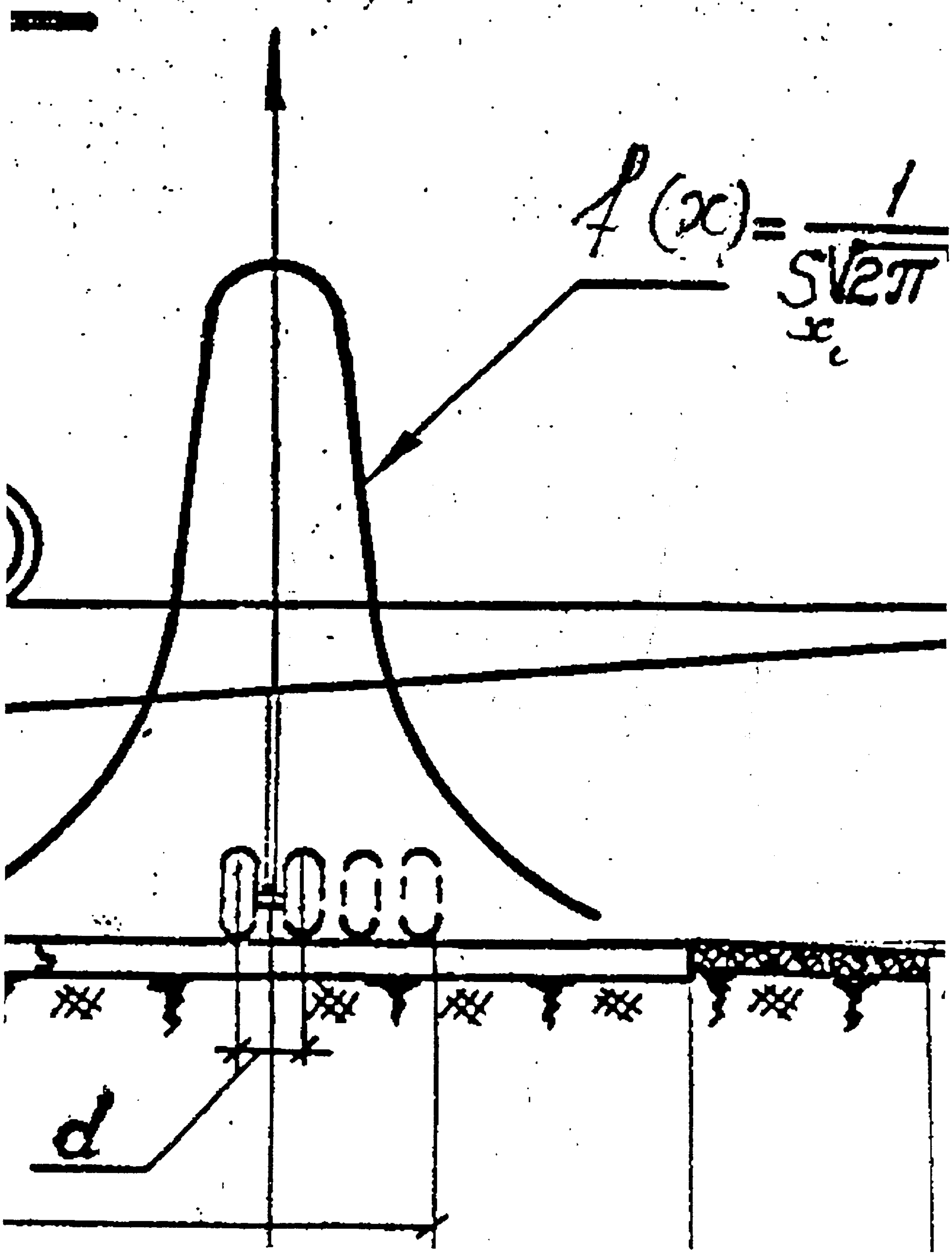
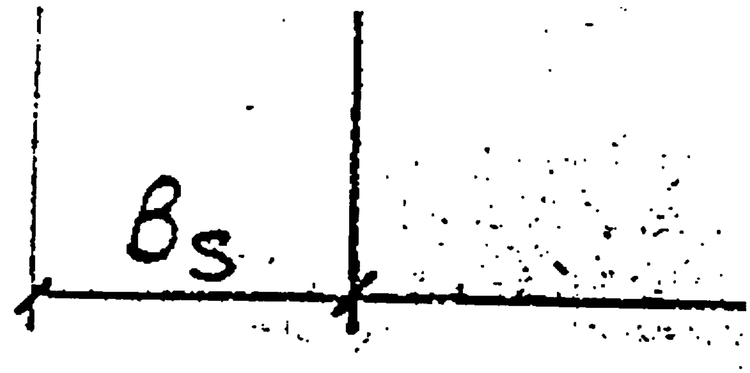


$f(x) = \frac{1}{S_{x_c}\sqrt{2\pi}}$
d

$$= e^{-\frac{(x-\bar{X}_i)^2}{2S^2_{x_i}}}$$

$+x$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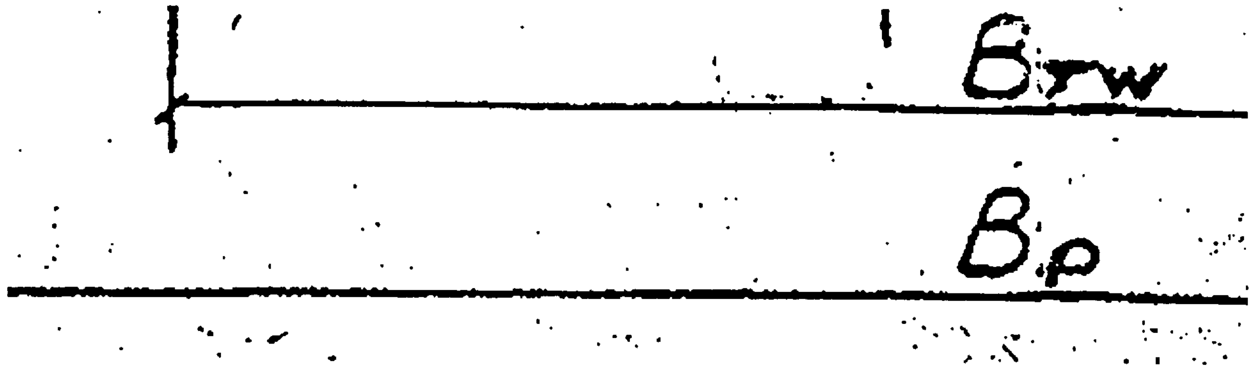
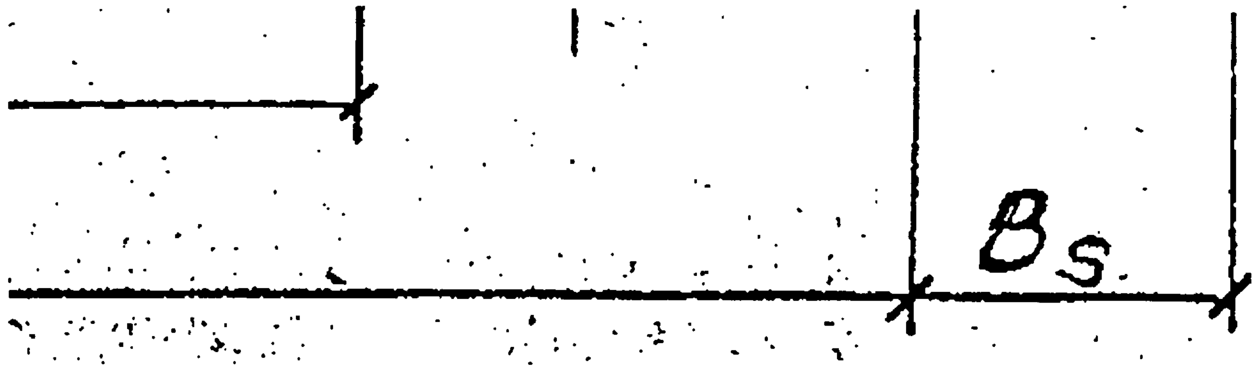
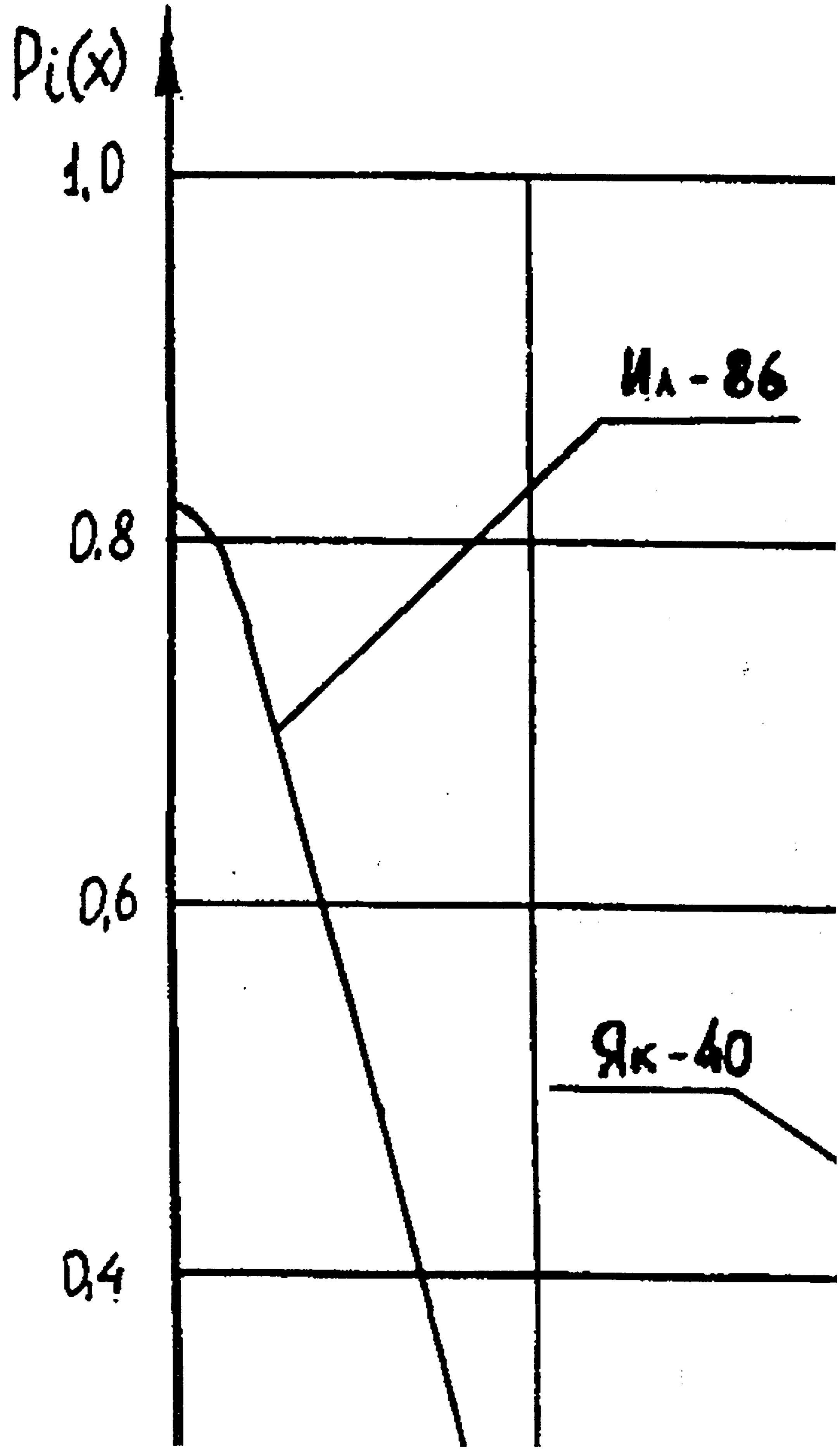
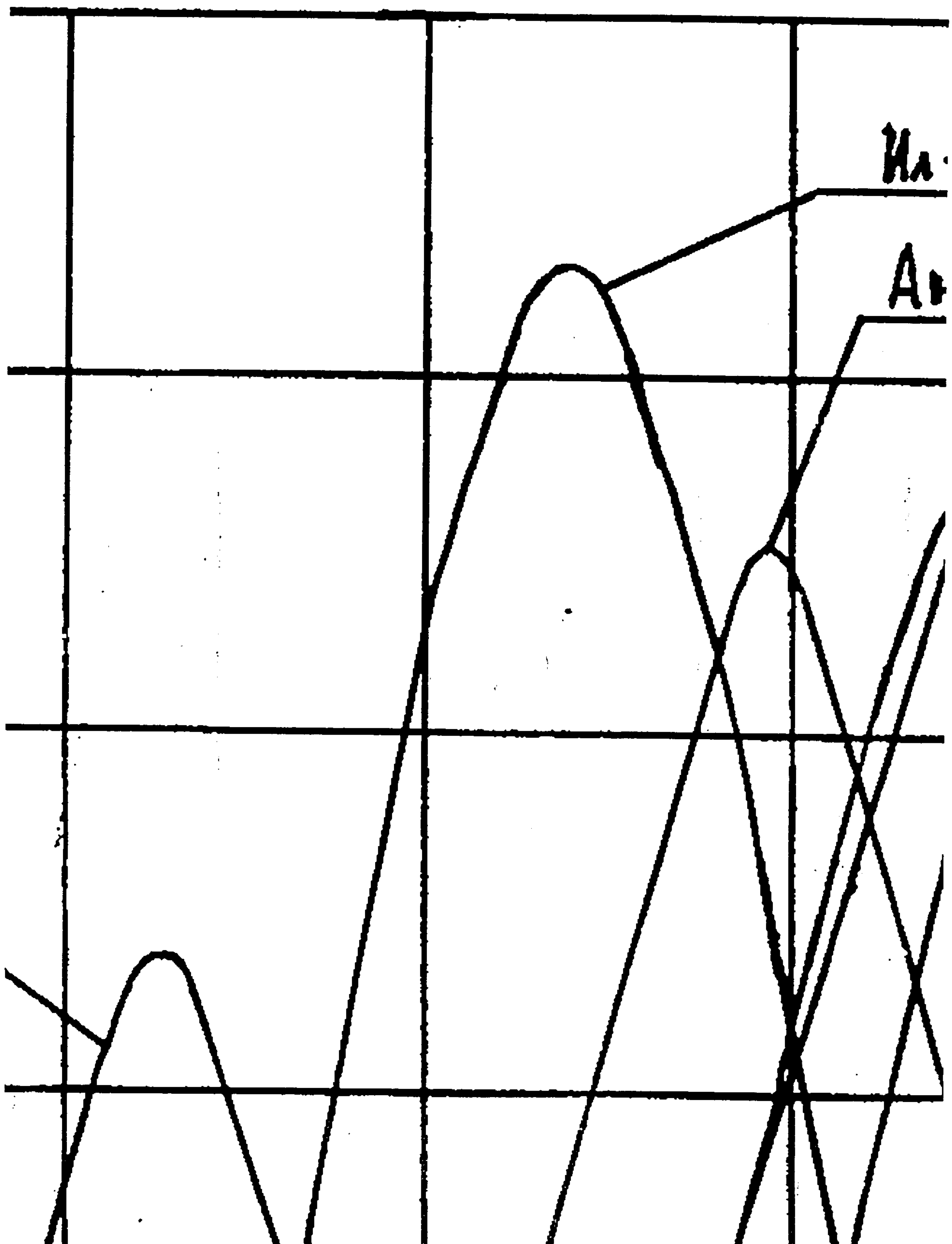
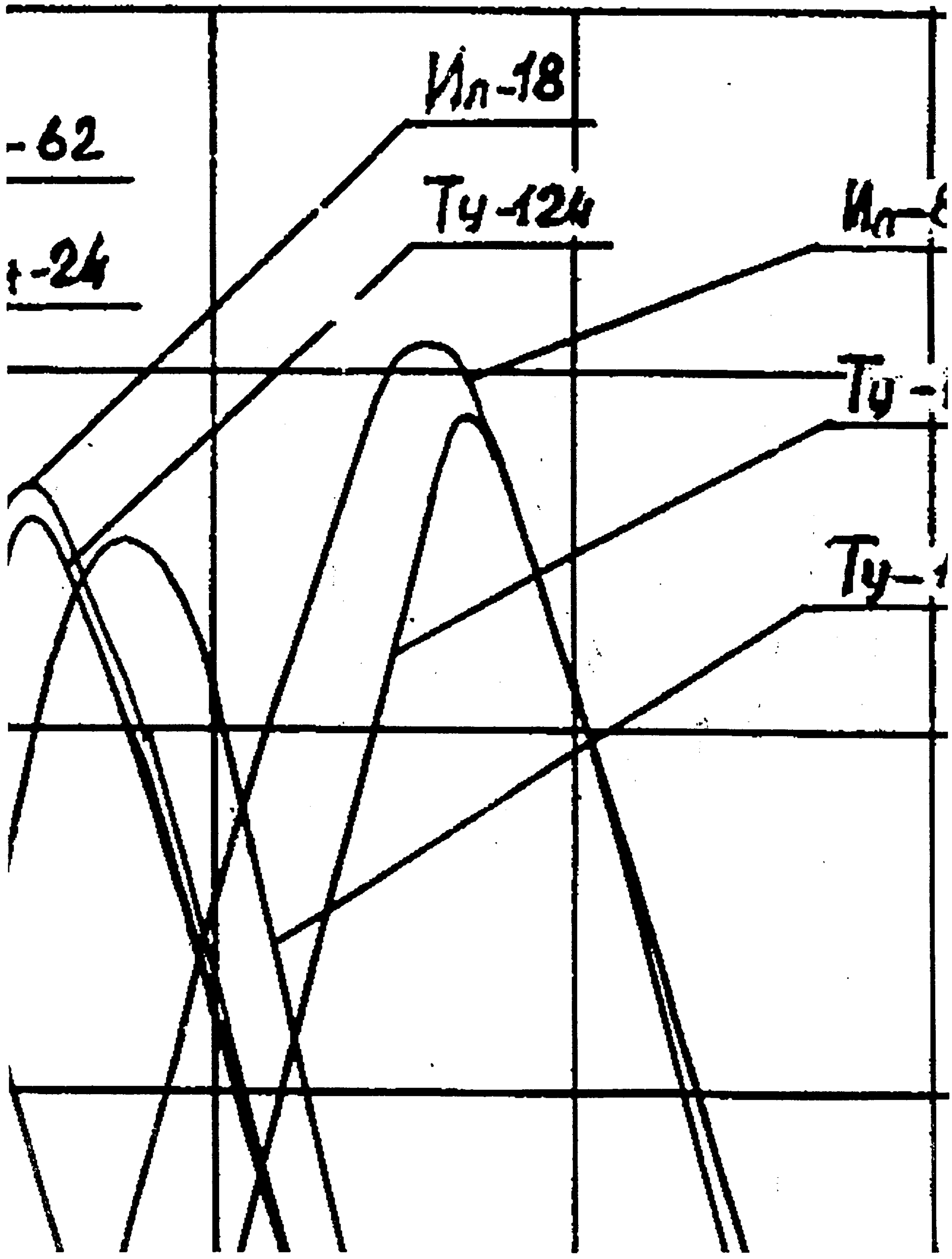

B TW
B P


Bs



Pi(x)
1,0
0,8
0,6
0,4
Ил - 86
Як - 40

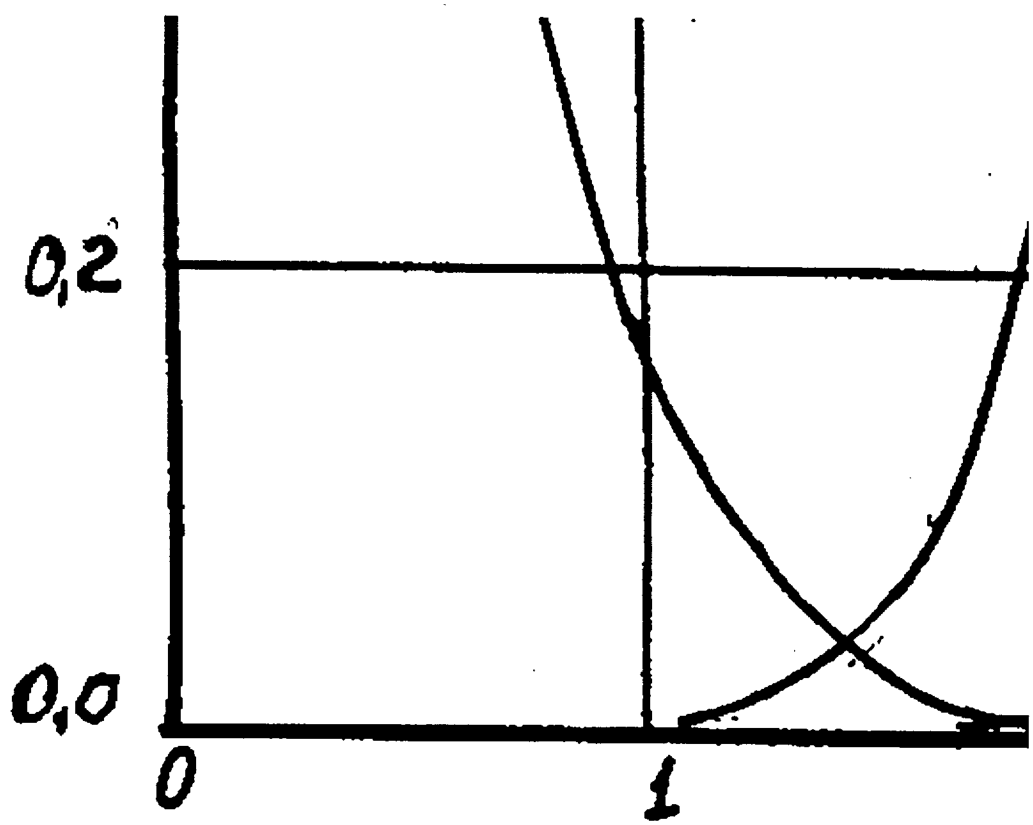

Ил
А

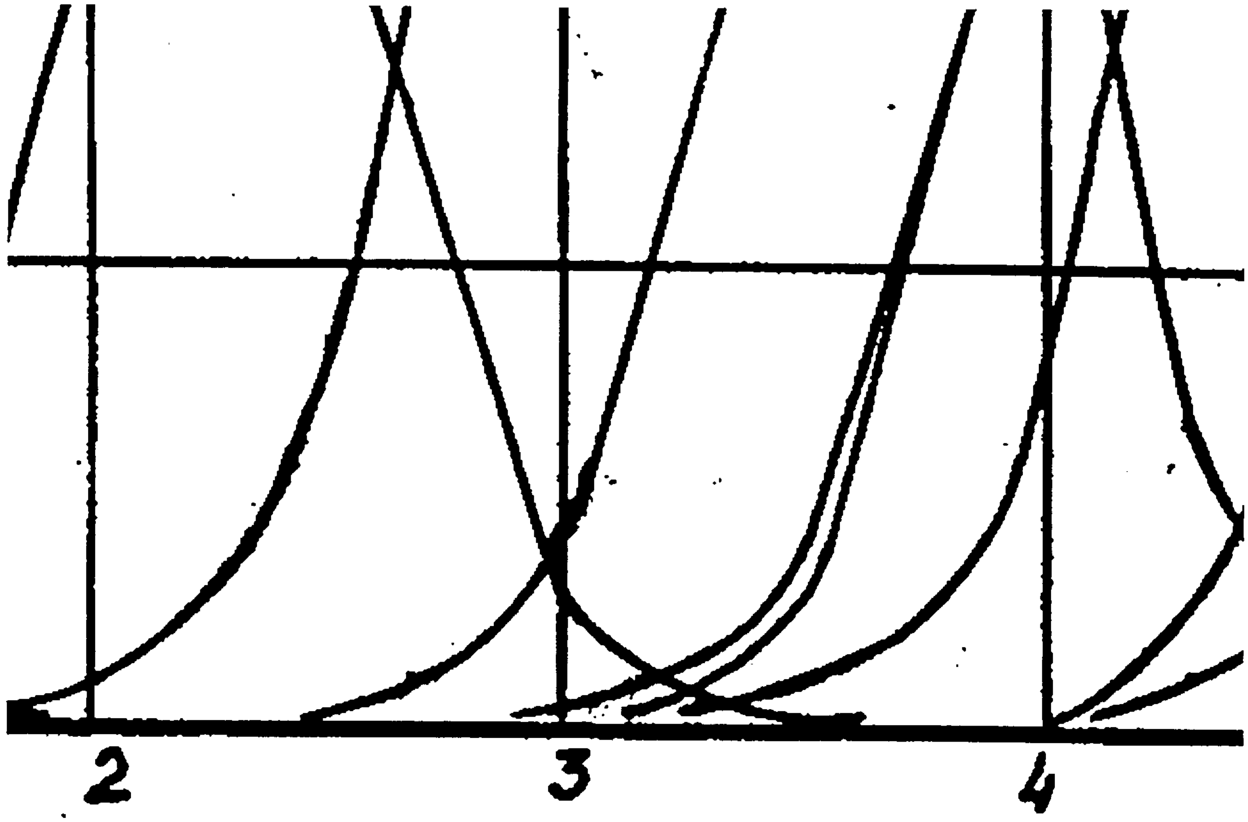

Ил-18
-62
Ту-124
-24
Ил-6
Ту-
Ту-

36

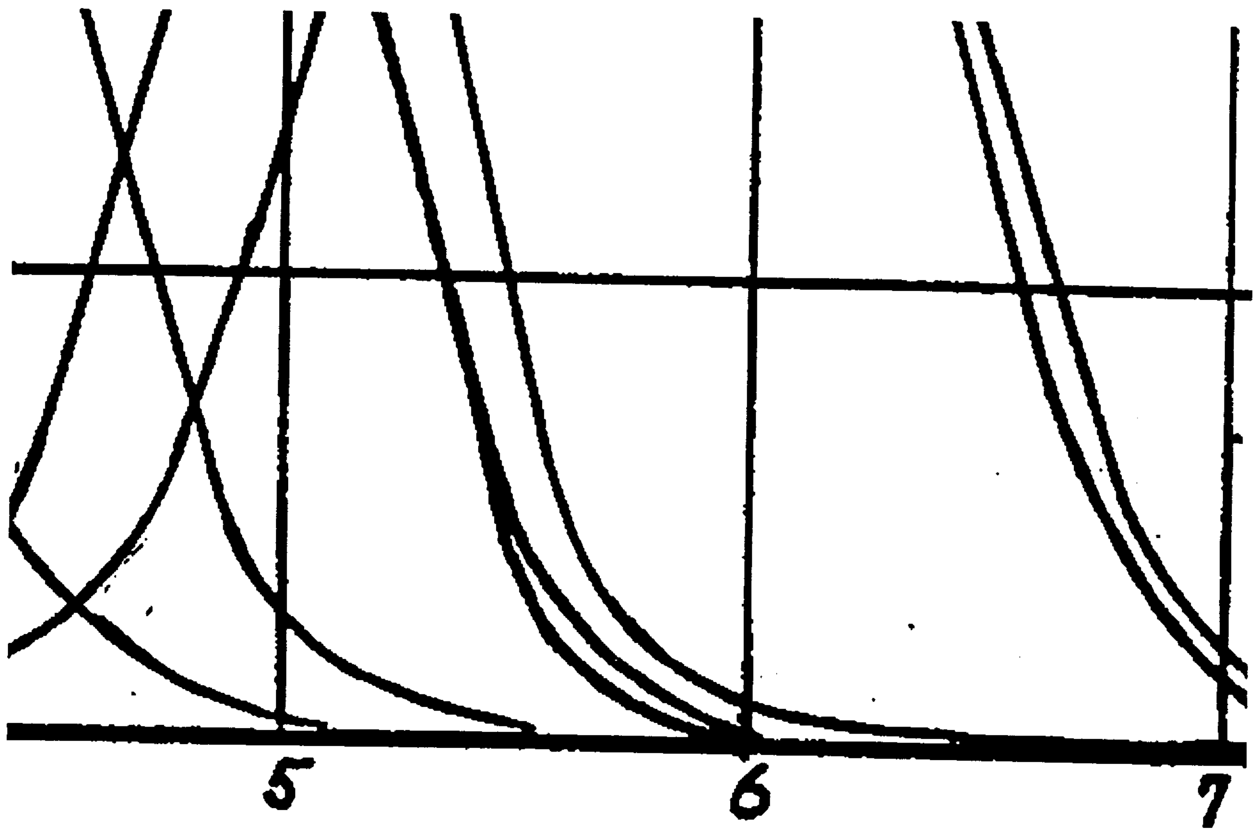
154

34

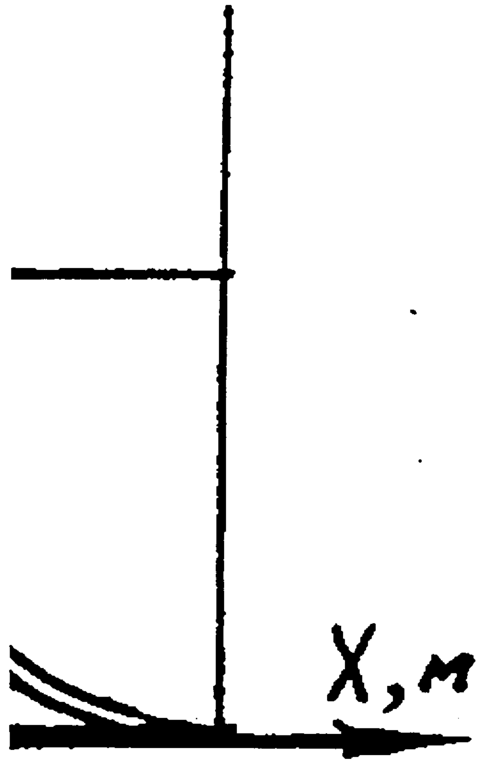

0,2
0,0
0
1

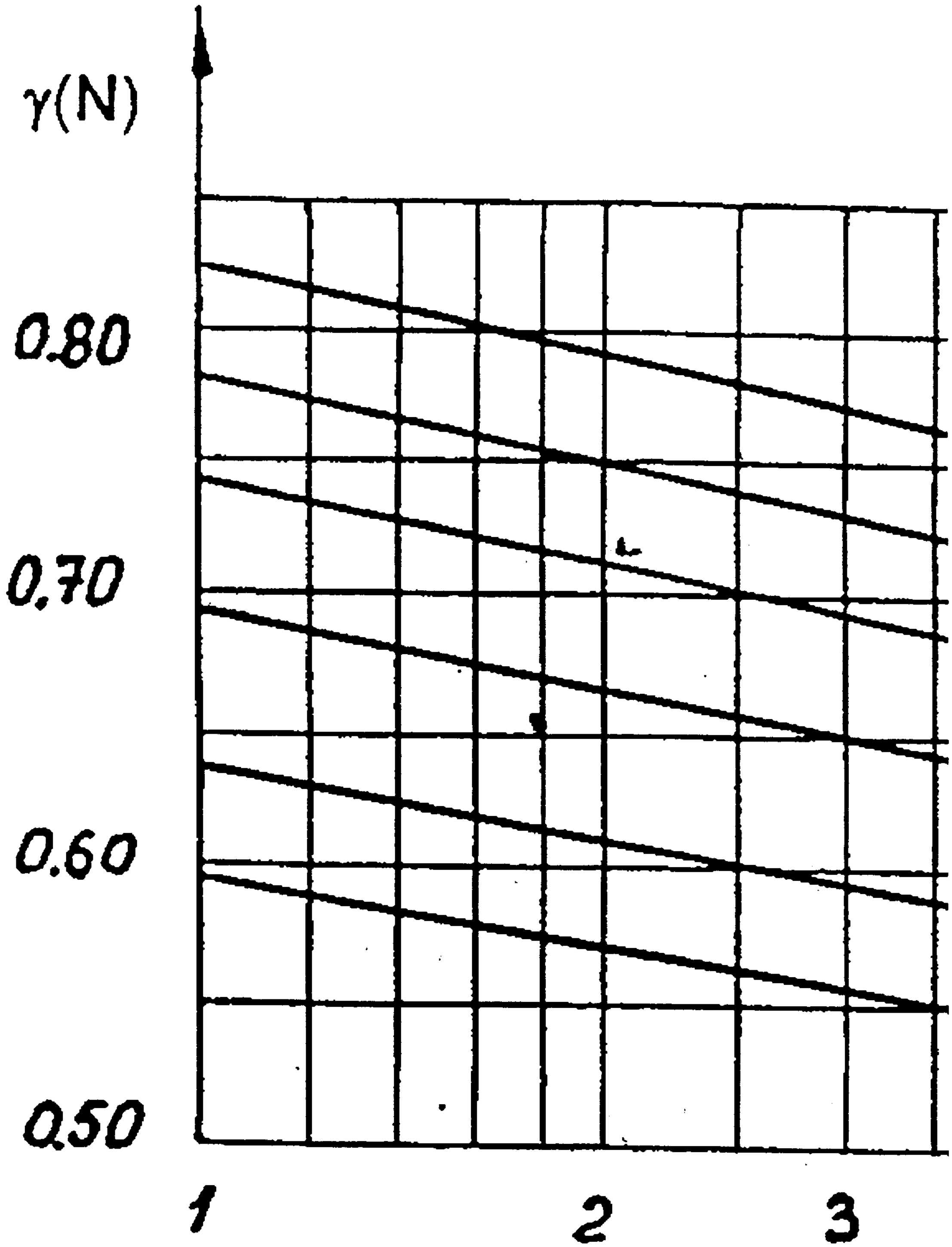


2
3
4

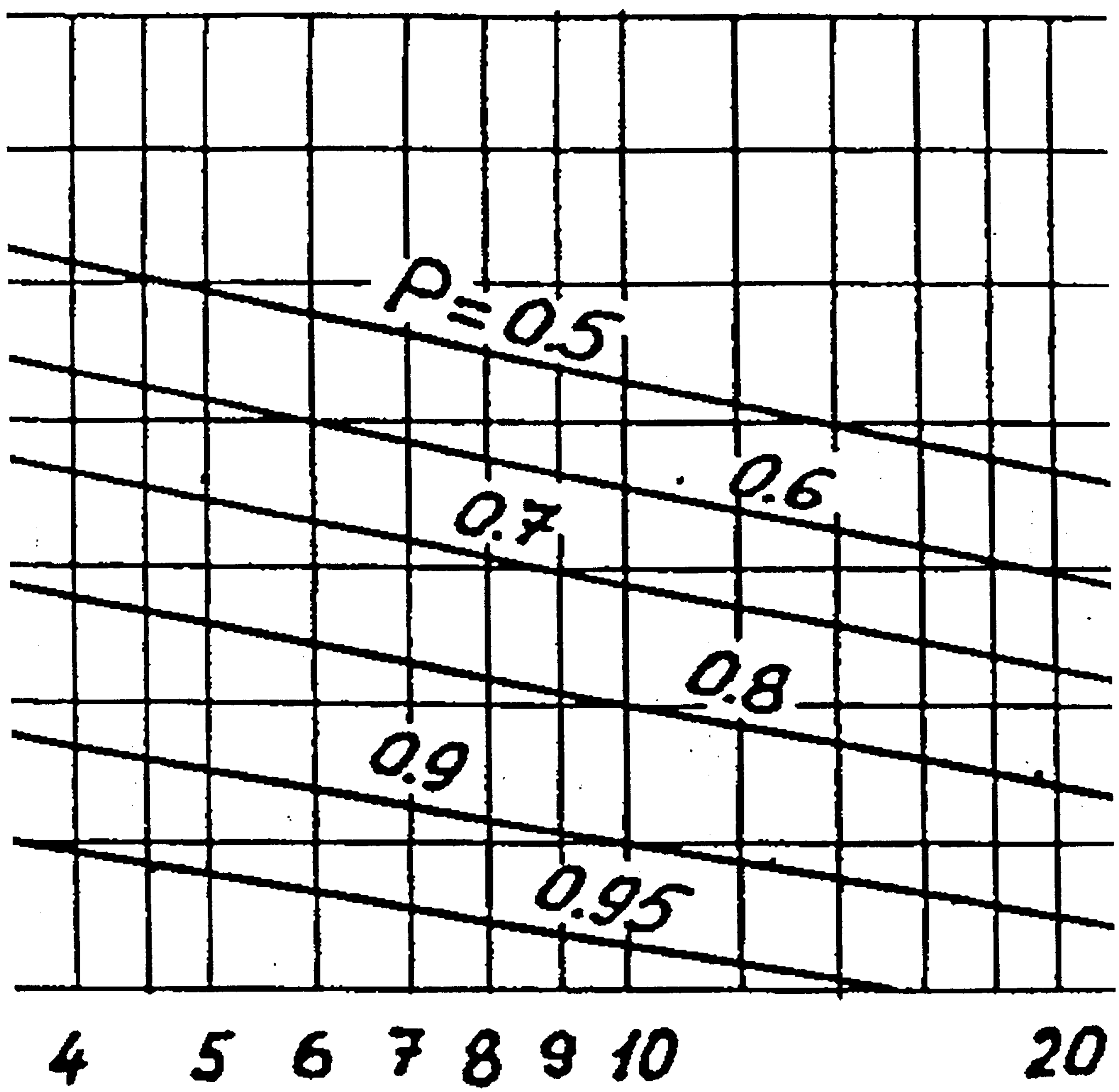


5
6
7

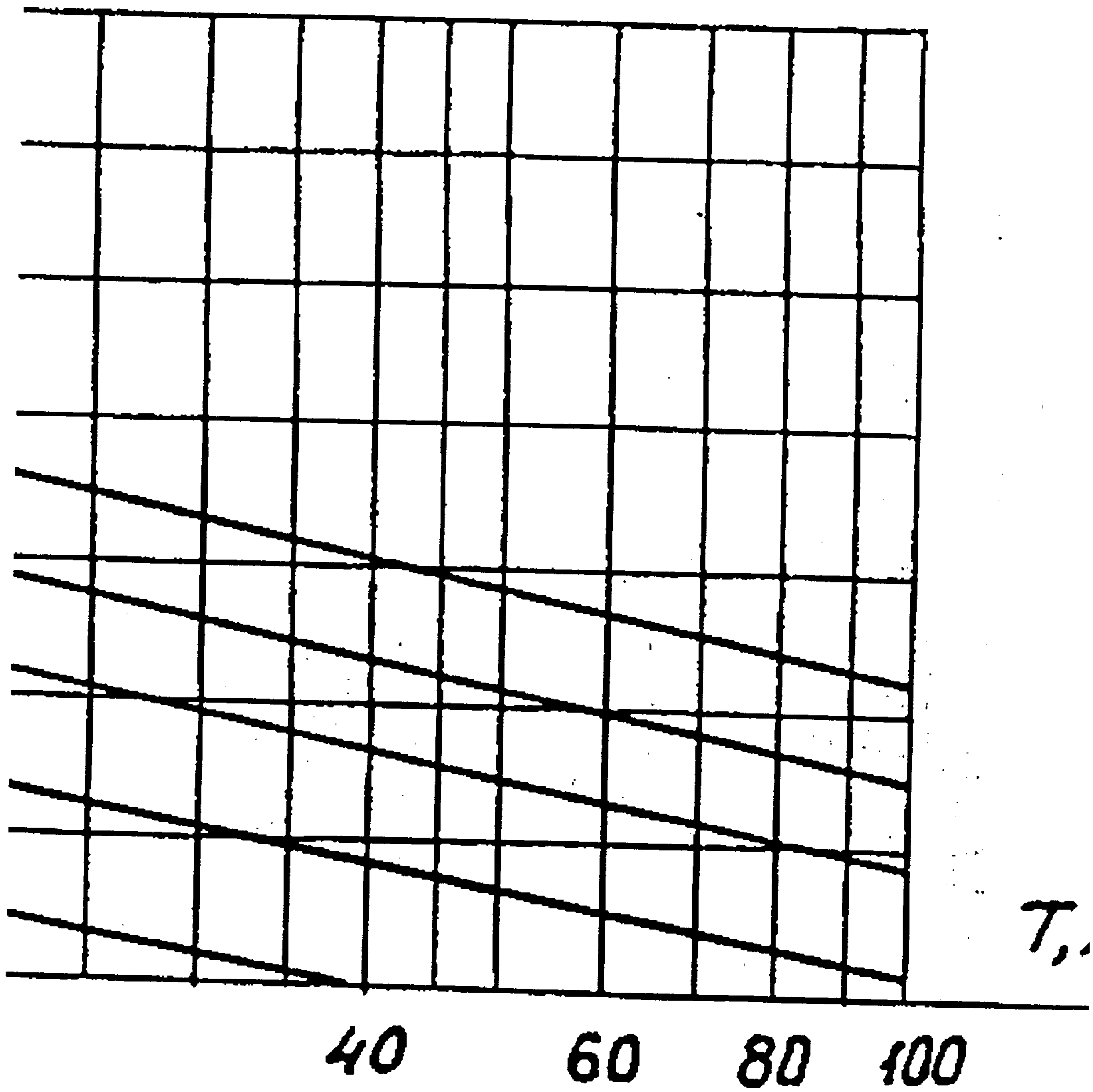

X, м



γ(N)
0.80
0,70
0.60
0.50
1
2
3



P=0.5
0.6
0.7
0.8
0.9
0.95
4
5
6
7
8
9
10
20



40
60
80
100
T,

ACT

The Propensity of Business Travellers to use Low Cost, Short Haul Airlines

Keith J Mason

Abstract

The liberalisation of air transport regulations in the EU has led to the introduction of a number of new airlines serving short haul point to point routes (e.g. Easyjet, Ryanair, Debonair, Virgin Express, Go, and others). While some of these routes are clearly leisure oriented, anecdotal evidence suggests that a significant number of travellers are using these services for business related trips. A number of recent studies suggest that pressure is being brought to bear on business travellers to reduce travel expenditure (IATA (1997), Bender and Stephenson (1998), Mason (1998)). This paper details a stated preference survey of European business travellers to assess the propensity for business travellers to use short haul low cost airlines. The survey will assess the utility placed by travellers on price, airline reward schemes, flight frequency and in-flight comfort service attributes. The study will examine the effect of company size on traveller's selection of these utilities by drawing a sample of business travellers.

Introduction

The completion of the single market for air transport within the EU has lead to significant changes in the airline industry. Perhaps the most visible demonstration of these changes is the establishment of a number of low fare, no or low frill airlines similar to those found in the US where such airlines account for some 25% of domestic US travel (Cassani, 1999, O'Toole, 1999).

While the principal target audience for these airlines is the price sensitive leisure traveller, there is some evidence that short haul business travellers are also prepared to use such services. Given the importance of the business travel market to traditional scheduled airlines, any move towards low cost services by a significant sector of the business travel market will have a dramatic effect on the scheduled airline industry in Europe. This paper, therefore, attempts to evaluate the propensity for business travellers to use low cost, low frills airlines in EU short haul markets.

European Business Travel

The completion of the single market for scheduled airline services in the EU has meant that any community established airline has the rights to fly between any two EU points. Following liberalisation, new entrant activity into duopoly markets has been relatively small. In 1992 only 4% of European routes in 1992 had more than two operators, and by 1997 this figure had only risen to 7%. On the densest routes, however, the increase in competition has been more dramatic with the proportion of routes with three of more competitors more than doubling to 26% (CAA, 1998a). Fourteen new start-up airlines began operations between March 1995 and September 1996 (Jones, 1996). Low cost, no or low frills airlines including Ryanair, easyJet, Virgin Express and Debonair have introduced the most routes. British Airways has also established a low cost wholly owned subsidiary, Go, which started trading in May 1998 to compete in this new and popular sector of the market. These airlines can afford to offer some very low fares by adopting a low cost strategy similar to the one pioneered by Southwest Airlines in the US. This activity has been particularly visible in the UK where low cost airline traffic (both EU and domestic) has risen from less than 2 million passengers in 1994 to over 7 million in 1998, and is estimated to rise to 9 million in 1999 (Morrell, 1999). Mainly operating from Luton and Stansted airports, these low cost airlines accounted for 15% of all traffic from London airports in 1998 (CAA, 1998b). The provision of new low fare alternatives are present in a market in which there is a high number of short haul business travellers. The UK CAA survey statistics show that 32% of all terminating passengers at the London airports are business passengers, a much higher proportion of short haul travel is business related. Table 1 shows principal short haul destinations from the UK to Europe. Overall, 48% of all passengers are travelling on business.

$3^1 \times 2^3$ possible combinations of options were possible with the vanables and levels adopted for the study, making 24 product designs to be evaluated by respondents. To reduce the combinations to a manageable number SPSS was used to develop an orthogonal design with eight product offerings to be evaluated by each respondent with an additional two hold out products that could be used to test the reliability of the results attained.

To evaluate the ten product designs (eight in the study and the two hold-outs) respondents were asked to rate the likelihood of choosing each product on a ten point scale each product, with a score of 1 indicating "very unlikely to choose the service" and 10 indicating "very likely to choose the service". Adopting a rating scale increased the data collected than would have been achieved by using a discrete choice model, it was viewed as being easier to complete in a self-completion survey administration method which had to be adopted given the nature of air travel with passengers arrive at the airport in waves. The researcher selected to administer the survey forms at two London airports, Stansted and Luton.

A pilot study of 10 respondents was performed prior to the full administration of the survey. Self completion of the survey form was found to take in the region of three minutes. The data were analysed using multiple linear regression. An adjusted R^2 of 0.48 was attained which was deemed to be acceptable for SP analysis. Three of the four variables were included in the stepwise produced model which was then use to predict the respondents scores for the hold out services. The model produced was:-

$$Score = 4.119 + (-0.0267 * Price) + (2.011 * In\text{-}flight\ product) + (0.719 * Frequency)$$

A correlation between the actual ratings given to the hold-out product designs and the model was 0.58. To test the reliability of the attitude scale the survey was performed on the pilot group a second time and the correlation between the original scores given and the score given in the re-test was 0.69. These tests of reliability on the stated preference instrument and on the attitude scale used within it were deemed acceptable.

The data were collected at Stansted Airport and London Luton Airport during a four day period during March 1999. Passengers of a traditional scheduled airline were surveyed at Stansted while passengers of a low cost airline were surveyed at Luton. 449 usable survey forms were collected (214 at Stansted and 234 at Luton). Some differences in the demographic and behavioural profiles of the two groups of respondents were observed. However, agreement to survey the passengers was attained on the understanding that any analysis would be made on aggregate data, and so these commercially sensitive differences are not presented in this paper. What can be noted is that when a dummy variable for departure airport was included in the regression analysis, a significant t-statistic for this variable was not attained. This indicates that differences in responses to the stated preference section of the survey could not be attributed to the type of airline (traditional or low cost) being used by the business travellers.

Results

The demographic profile of the respondents were similar to previous studies of short haul business travellers in Europe. 33.0% of respondents described themselves as company directors with 30.1% indicating that they were employed as senior managers, while another 20.5% worked in "other management" positions. Together this means 83.6% of respondents fell into the A or B social classifications. This finding is very similar to a 1997 study of business travellers which found 86.9% of business travellers at Stansted were in the same social classifications (Mason, 1998). 26.7% of respondents worked in very small companies (with less than 25 employees). 14.7% of respondents worked in companies with between 25 and 100 employees, while a further 20.0% of the sample worked in medium sizd companies (up to 1000 employees). The remaining 38.5% of respondents indicated that they worked for companies with more than 1000 employees. This corporate profile is not very similar to the previous study in which 57% of the sample worked for companies with more than 1000 employees. This anomaly may be explained as this sample was taken on passengers of both traditional carriers and low cost airlines, whereas the earlier study was on performed solely on passengers of traditional carriers. It is possible that a larger proportion of business travellers using

It is the with addition of additional in-flight comfort and benefits, along with the additional frequencies, that the price rise becomes acceptable to the market (table 5).

Table 5: Scenario Analysis for In-flight Comfort and Frequencies

Scenario	Class	FFP	Freq	Price	Model 1	Model 2	Model 3	Model 4
1	1	0	2	100	5.838	5.302	5.219	4.681
2	2	0	5	150	6.934	6.883	6.775	6.776
Change in attractiveness					15.81%	22.96%	22.96%	30.92%

In a final example, table 6 demonstrates the effects of a £25 price rise, with the introduction of FFP rewards. The price rise is unattractive to the travellers working for companies with less than 100 employees, however there is only a marginal difference in the third group and the model indicates that this change would be attractive to those working for the largest companies.

Table 6: Scenario Analysis for FFP Rewards

Scenario	Class	FFP	Freq	Price	Model 1	Model 2	Model 3	Model 4
1	1	0	3	150	4.849	4.392	4.504	4.128
2	1	1	3	175	4.295	3.845	4.449	4.183
Change in attractiveness					-12.91%	-14.21%	-1.22%	1.30%

Discussion

Although the findings in this paper are not surprising, they support the view made in the literature that low cost airlines would be more attractive to travellers working for small and medium sized companies, and provides original evidence of the effect of company size in the purchase decision process for short haul business air travel. The findings provide useful marketing information to airline managers for both low cost and traditional airlines. The models derived can be used to assess the effects of changes in price, in-flight comfort, frequency, and FFP rewards on the market. Of course changes in product provision will also affect airline costs and these have not been considered here. More importantly the research allows further consideration of the likely adoption of low cost airline services by EU business travellers. The models of the four market groups, selected on the basis of the size of the company that the traveller works for, can be used to assess the likely changes in market attraction to changes in product offerings. However, these models must be built into an aggregate model of the market so that changes in market attractiveness can be extrapolated to assess changes in demand and consumption. To do this a profile needs to be developed that splits the market into the four grouping used to develop the models in this paper, and also the number of trips taken by each group. These data are not readily available. Of course, the sample taken for this research could be used, however, the profiles of the sample did not seem to be truly representative of the entire short haul business market, as noted earlier. As the market is in change it would seem that further work can be undertaken in this area to develop a predictive model of the short haul business travel market in Europe.

The research shows that the introduction of low cost airlines in Europe has attracted a significant proportion of the market. Liberalisation in this sector in Europe has provided greater competition and choice which has revealed the short haul business traveller to be more price sensitive than historical evidence would suggest, and the models derived here support this view.

Model for companies with more than 1000 employees

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
4	.513	.263	.261	3.1056

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	4746.239	4	1186.560	123.027	.000
	Residual	13300.038	1379	9.645		
	Total	18046.277	1383			

Coefficients

Model		Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.
4	(Constant)	3.663	.361		10.148	.000
	PRICE	-1.626E-02	.001	-.373	-16.149	.000
	ECO_BUS	2.124	.167	.294	12.723	.000
	FREQ	.262	.033	.182	7.859	.000
	FFP	.462	.167	.064	2.770	.006